TERRA NOSTRA

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Sixth Workshop on

Russian-German Cooperation: Laptev Sea System

Program and Abstracts

State Research Center - Arctic and Antarctic Research Institute
St Petersburg, Russia

October 12-14, 2000

Funded by the German and Russian Ministries for Science and Technology

IMPRESSUM

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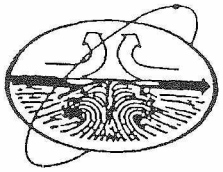

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Program

Sessions and events at a glance

Tuesday, 10 Oct./Wednesday, 11 Oct., 2000

Arrival and transfer to the hotels

Wednesday, 11 Oct., 2000

17 00	Registration at the AARI
19·00	Icebreaker party at the AARI
21 00	Transfer to the Hotel Pribaltiyskaya/Hotel Chayka

Thursday, 12 Oct., 2000

08 30	Transfer from the Hotel Pribaltiyskaya/Hotel Chayka to the AARI
09 00	Welcome and opening remarks
11·00	Oral session: Onshore and offshore permafrost
13 00	Lunch at the AARI
15 10	Poster session· Onshore and offshore permafrost
17 00	Opening of the Otto Schmidt Laboratory for Polar and Marine Sciences
18·00	Poster session The 2000 Fellowship Program of the Otto Schmidt Laboratory
19 00	Banquet at the Otto Schmidt Laboratory for Polar and Marine Sciences
21 30	Transfer to the Hotel Pribaltiyskaya/Hotel Chayka

Friday, 13 Oct., 2000

08:30	Transfer from the Hotel Pribaltiyskaya/Hotel Chayka to the AARI
09·00	Oral session Effects of environmental changes
11 40	Poster session Effects of environmental changes
13 30	Lunch at the AARI
14 30	Oral session Short- and long-term environmental changes in the central Siberian Arctic
17:50	Poster session· Short- and long-term environmental changes in the central Siberian Arctic
19:30	Transfer to the Hotel Pribaltiyskaya/Hotel Chayka

Saturday, 14 Oct., 2000

08 30	Transfer from the Hotel Pribaltiyskaya/Hotel Chayka to the AARI
09 00	Oral session Terrestrial/marine interactions in coastal zones
11.20	Poster session: Terrestrial/marine interactions in coastal zones
13 00	Lunch
14 00	Internal meetings and workshops
18·00	Social event

Sunday, 15 Oct., 2000

Transfer to the airport and departure

Thursday, 12.10.2000

Welcome, opening remarks and expedition reports

Chairperson: S. Priamikov and H. Kassens

09:00 **J. Thiede and I. Frolov.** Russia-German Cooperation in the Laptev Sea

H. Kassens, I. Dmitrenko, and Scientific Parties of the TRANSDRIFT expeditions. TRANSDRIFT I-VIII Understanding the environmental system of the Laptev Sea

V. Rachold, M.N. Grigoriev, and the participants of the expedition. The expedition LENA 2000: Overview and first results

L.M. Savatyugin, N.I. Vasiliev, V.M. Zubkov, B.B. Kudryashov, R.N. Vostretsov, A.N. Dmitriev, H. Miller, D. Fritzsche. Drilling by electromechanical method on Akademiya Nauk Glacier, Severnaya Zemlya Archipelago

L.A. Timokhov, H. Kassens, J. Hoelemann, S. Priamikov, K. Tuschling, J. Thiede. The Otto Schmidt Laboratory for Polar and Marine Sciences

10.30 *Coffee*

Oral Session: Onshore and offshore permafrost

Chairpersons: N.N. Romanovskii and H. Meyer

11 00 **E.-M. Pfeiffer, V. Samarkin, D. Wagner.** Methane flux studies in Siberia - conclusion and open questions about the impact of climat change on permafrost soils

11:30 **V. Samarkin, D. Wagner, E.-M. Pfeiffer.** Controls of methane flux from polygonal tundra cryosols

11:50 **W. Müller-Lupp, M. Bölter, Y. Kodama, T. Ohata, K. Takata, H. Yabuki.** Evidence of climatic and physical properties in Arctic soils

12 10 **H.-W. Hubberten, N.N. Romanovskii.** Terrestrial and offshore permafrost distribution and evolution during 400 kyr, Laptev Sea region

12 40 **A.L. Kholodov, N.N. Romanovskii, G.S. Tipenko, H.-W. Hubberten.** Ice-bonded and ice-bearing offshore permafrost on the Laptev Sea shelf

13 00 *Lunch*

14.00 **V.E. Tumskoy, G.S. Tipenko, N.N. Romanovskii.** Thermokarst lake and lake taliks formation on the base of an ice complex: Duration and permafrost effect

14 20 **F. Niessen, A. Gierlichs, M. Wessels.** Acoustic signatures from the Laptev Sea submarine permafrost - physical state and stability in Holocene times

14 40 *Coffee*

Poster session: Onshore and offshore permafrost

15·10 **Chairpersons M. Grigoriev and F. Niessen.** Introduction to the poster session: Onshore and offshore permafrost

The following poster presentation belonging to this session will be given in the main hall of the AARI Presenters will be in attendance between 15 10 and 17 00

M. Bölter, W. Müller-Lupp, Y. Kodama, T. Ohata, K. Takata, H. Yabuki. Potential long-term CO_2 flux in an arctic tundra environment

G. Delisle, M. Allard. Recently emerged marine sediments on the shores of the Hudson Bay - a modern analog to conditions prevailing during the last marine regression from the Laptev Sea shelf/Siberia?

A. Dereviagin, H. Meyer, A. Chizhov, H.-W. Hubberten. The recent stage of ice wedge formation in the region of the Late Pleistocene ice complex spreading (on evidence of isotopic analyses)

A. Gierlichs, F. Niessen, W. Jokat. Gas instead of permafrost? New results of high-resolution seismic investigations of near-surface shelf sediments in the Laptev Sea

G. Große, L. Schirrmeister, V.V. Kunitzky, T. Kuznetsova, V.Tumskoy. Quaternary sediments of the south coast of Bol'shoy Lyakhovsky Island

N. Kaul. Seismicity, heat flow, and their role for submarine permafrost stability

V. Kunitsky, L. Schirrmeister, G. Große, V. Tumskoy. Nival landscapes and the Ice Complex formation in the Laptev Sea coastal zone

A.N. Kurchatova, D. Wagner, H. Becker, G. Stoof, E.-M. Pfeiffer. The methane concentration in ice wedges of different generation/the Lena delta

L. Kutzbach, D. Wagner, H. Becker, E.-M. Pfeiffer. The influence of vegetation and soil parameters on methane emission from a wet polygonal tundra

W. Müller-Lupp, M. Bölter, R. Horn. Freezing-induced changes of mechanical properties in permafrost-affected soils

W. Müller-Lupp, M. Bölter, Y. Kodama, T. Ohata, K. Takata, H. Yabuki. Constraints for soil microbiology activity and soil properties in an arctic tundra environment

I.S. Parmouzin, S.I. Pokrovsky, N.N. Romanovskii, G.S. Tipenko. The role of the neotectonic movements in the formation of permafrost thickness

C. Siegert, L. Schirrmeister, O. Baby. Facial conditions of Ice Complex formation on the Bykovsky Peninsula - results from sedimentological, mineralogical, and geochemical studies

D. Wagner, H. Schröder, S. Kobabe, H. Kassens, E. Damm, E.-M. Pfeiffer. Microbial methane in the system sediment-water column-ice sheet of the Laptev Sea

I.A. Yakshina. Chemical characteristics of permafrost soils of the Lena delta and New Siberian Islands

I.A. Yakshina. Top-soil of Zhokhov Island (New Siberian Archipelago)

Opening of the Otto Schmidt Laboratory for Polar and Marine Sciences

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17:00 Representatives of the German and Russian Ministeries for Sciences and Technology

Poster Session: The 2000 Fellowship Program of the Otto Schmidt Laboratory for Polar and Marine Sciences

18.00 **Chairperson: H. Kassens and L.A. Timovkhov.** Introduction to the poster session: The 2000 Fellowship Program of the Otto Schmidt Laboratory

The following poster presentation belonging to this session will be given in the main hall of the OSL (7th floor) Presenters will be in attendance between 18 00 and 19 00

D.Yu. Bolshiyanov, G.B. Fedorov, L.A. Savelieva. Climate changes and sea level oscillations in the Laptev Sea region in Holocene as inferred from the data on the continental circumference (Taimyr Peninsula, Lena River delta, Severnaya Zemlya, and Novosibirskie Ostrova archipelagos)

I.A. Dmitrenko, S.L. Berezovskaya, S. Kirillov. Vertical exchange under stratified water condition in the Laptev Sea: Potential impact on hydrology, ice, and redistribution of suspended sediments

S. Drachev, A.S. Roudoy, D.I. Chizhov. Tectonics of the Laptev Sea shelf and its impact on marine paleoenvironment

M.N. Grigoriev, E.Yu. Pavlova, P.V. Rekant, M.V. Dorojkina. The history of sediment transport along the Lena delta - Laptev Sea shelf transect during the Late Pleistocene-Holocene

S. Pivovarov, M. Nitishinsky, E. Kirillova. Influx and transformation of nutrients on the arctic shelf

N.N. Romanovskii, A.L. Kholodov, V.E. Tumskoy. Evolution and modern state of offshore and onshore permafrost and the role in sea-land interaction Laptev Sea region

A. Sher, S. Kuzmina, T. Kuznetsova. LAPPAL - the database on the Pleistocene environment of the East Siberian arctic shelf (Laptev Land Paleoecology) Preliminary report I

V.P. Shevchenko, A.A. Klyuvitkin, A.N. Novigatsky. Atmospheric input of natural and anthropogenic tracers into the Laptev Sea and adjacent Arctic Ocean

E. Taldenkova, H. Bauch, A. Stepanova, A. Ovsipyan. Detailed paleontological and paleoenvironmental studies on the eastern Laptev Sea shelf

Friday, 13.10. 2000

Oral session: Effects of environmental changes

Chairpersons: I.A. Dmitrenko and K. Tuschling

09:00 **I.A. Dmitrenko, J.A. Hölemann, S.A. Kirillov, S.L. Berezovskaya, H. Kassens, H. Eicken.** Wind-forced currents. linkage between the eastern Laptev Sea and Arctic Ocean?

09:30 **J.A. Hölemann, I. Dmitrenko, H. Kassens.** Transport pathways and hydrographic conditions in the Laptev Sea

09.50 **S.A. Kolesov, I.Yu. Kulakov, L.A. Timokhov.** Modeling of 3-D water circulation in the Laptev Sea

10.10 **S.V. Pivovarov, M. Nitishinsky, E. Kirillova.** Annual and interannual variability of nutrients in the Laptev Sea

10·30 *Coffee*

11.00 **M.K. Schmid, E. Abramova, A. Gukov, V. Petriashov, B. Sirenko, M. Spindler, K. Tuschling.** The biology of the Laptev Sea

11 20 **K. Tuschling, K. Meiners, M.K. Schmid, J. He.** Early spring phytoplankton distribution and activity in ice-covered waters near the Laptev Sea polynya

Poster session: Effects of environmental changes

11·40 **Chairpersons S.A. Kolesov and J.A. Hölemann.** Introduction to the poster session· Effects of environmental changes

The following poster presentation belonging to this session will be given in the main hall of the AARI Presenters will be in attendance between 11 40 and 13 30

E. Abramova, K. Tuschling. Vertical zooplankton distribution during day and night time in September 2000 - Preliminary results

E.N. Abramova. The pelagic invertebrate fauna of the Laptev Sea shelf

S.L. Berezovskaya, I.A. Dmitrenko, S.A. Kirillov, J.A. Hölemann, H. Kassens. Dynamics of currents in the eastern Laptev Sea in terms of fractal analysis of the ADCP records

N.V. Chernova. Ichthyofauna of the Laptev Sea Composition and structure

A.Yu. Gukov, I.A. Yakshina. Preliminary results of a littoral fauna study on Novaya Sibir Island

J. Hölemann, I. Dmitrenko, C. Wegner. Wind-forced sediment transport on the Laptev Sea shelf

A.Yu. Ipatov. Pressure and wind variance - spatial and year-to-year variability

H. Kassens, H.A. Bauch, S. Drachev, A. Gierlichs, F. Niessen, J. Thiede, M. Wessels E. Taldenkova, A. Rudoy. First Impressions of TRANSDRIFT VIII expedition to the Laptev Sea The shelf drilling campaign of "Laptev Sea System 2000"

S.A. Kirillov, I.A. Dmitrenko, S.L. Berezovskaya, J.A. Hölemann, V.N. Churun, H. Kassens. Baroclinity of currents as a cause for seasonal salinity variations in the eastern Laptev Sea

K.N. Kosobokova, H.-J. Hirche. Reproduction of the arctic copepod *Calanus glacialis* in the Laptev Sea in relation to food availability and ice cover

M. Nitishinsky. The modeling of the nutrient fluxes at the Laptev Sea boundaries

V.K. Pavlov. Seasonal and long-term variability of the sea level in the marginal seas of the Arctic Ocean

S.A. Petushkov, E.A. Zakharchuk. Low-frequency wave perturbations in the field of currents in the Laptev and East Siberian seas

L.A. Savelieva, M.V. Dorojkina, E.Yu. Pavlova. First results of the pollen monitoring in the Lena delta (according to the content of pollen traps)

M.K. Schmid, M Spindler, K. Tuschling. Carbon sources and sinks in the Laptev Sea

A.A. Vinogradova, T.Ya. Ponomareva, V.P. Shevchenko. Long-term seasonal variations in atmospheric pollution near the Laptev Sea

C. Wegner, J.A. Hölemann, I. Dmitrenko, H. Kassens, Shipboard Scientific Party of the TRANSDRIFT VIII expedition. Dynamics of particle transport on the Laptev Sea shelf: First results of 36 hours monitoring studies (TRANSDRIFT VIII)

A.S. Zachek, A.M. Bezgreshnov, B.V. Invanov. Weather, atmospheric circulation, and heat exchange conditions in the Laptev Sea during the TRANSDRIFT VII 1999 and TRANSDRIFT VIII 2000 expeditions

V.V. Zernova, E.-M. Nöthig, V.P. Shevchenko. Role of diatoms in the vertical particle fluxes in the northern Laptev Sea (sediment trap data)

13·30 *Lunch*

Oral session: Short-and long-term environmental changes in the central Siberan Arctic

Chairpersons: S. Drachev and D. Fuetterer

14 30 **H.A. Bauch, H. Cremer, H. Erlenkeuser, P.M. Grootes, H. Kassens, M. Kunz-Pirrung, T. Müller-Lupp, O. Naidina, V.V. Petryashov, Ye. Polyakova, R.F. Spielhagen, E. Taldenkova, J. Thiede.** A synthesis of the paleoenvironmental evolution of the Laptev Sea shelf during the Holocene

15 00 **Y.I. Polyakova, H.A. Bauch.** Sea-ice and hydrological conditions in the Laptev Sea during the past 9000. Evidence from diatom assemblages

15.20 **T. Müller-Lupp, H. Erlenkeuser, H.A. Bauch, Y. Taldenkova.** Modern and paleoenvironmental cyclicity in the eastern Laptev Sea as shown in stable isotope profiles from shells of living and fossil bivalves

15 40 **C. Strobl, M. Molnar, S. Schaeper, V. Schulz, C. Woda, D. Hoffmann, A. Mangini, P. Kubik, M. Suter.** Determination of ^{10}Be pathways from the shelf area of the Laptev Sea to the central Arctic Ocean as the prerequisite for the dating of sediment core PS2185-3/-6 from the Lomonosov Ridge

16.00 *Coffee*

16·30 **L. Schirrmeister, Ch. Siegert, H.-W. Hubberten.** Permafrost deposits in the Laptev Sea region as Quaternary paleoenvironmental archives - potentialities and perspectives

16 50 **A. Sher, S. Kuzmina.** Mosaic arctic grassland, swamp, or barren tundra Problems of the environmental reconstruction of the Ice Complex deposition time

17 10 **M.A. Anisimov, V.E. Tumskoy.** First results of paleogeographic and cryolithological investigations on New Siberia Island (2000)

17 30 **D. Odess.** Early Holocene environment and economy in the Laptev Sea region. A preliminary view from Zhokhov Island

Poster Session: Short-and long-term environmental changes in the central Siberian Arctic

17:50 **Chairpersons: A. Sher and T. Müller-Lupp** Introduction to the poster session· Short-and long-term environmental changes in the central Siberian Arctic

The following poster presentation belonging to this session will be given in the main hall of the AARI Presenters will be in attendance between 17 50 and 19 15

A.A. Andreev, C. Siegert, L. Schirrmeister, H.-W. Hubberten. Vegetation and climate changes on Bykovsky Peninsula, Laptev Sea coast, during the last 60,000 years by pollen data

A.A. Andreev, G. Schwamborn, V. Rachold, M.N. Grigoriev. High-resolution Late Holocene paleoenvironmental records from Nikolai Lake, Arga Island, Lena River delta

M.A. Anisimov, V.V. Pitulko. Zhokhov-2000 Geography, paleoenvironment, and archaeology

H. Kassens, H. Bauch, S. Drachev, A. Gierlichs, F. Niessen, A. Rudoy, E. Taldenkova, J. Thiede, M. Wessels. The TRANSDRIFT VIII expedition to the Laptev Sea: The shelf drilling campaign of "Laptev Sea System 2000"

F. Kienast, A. Andreev, L. Schirrmeister, C. Siegert. Plants as climatic indicators - The potential of paleobotanical methods exemplified by means of the dated sequence of Mammontovy Khayata

S. Kuzmina, T. Kuznetsova. Pleistocene deposits and insects of Bol'shoy Lyakhovsky Island (preliminary data)

T. Kuznetsova, L. Schirrmeister, V. Kunitsky, S.A. Kuzmina, G. Große, D.Yu. Bolshiyanov. Permafrost deposits as archives for paleoclimate and paleoenvironment - expeditions to the Olenyokskaya Channel, 2000

H. Meyer, A. Dereviagin, C., Siegert, H.-W. Hubberten. Climatic trends in the Late Quaternary as deduced from ice wedges of Northern Siberia

E.E. Musatov. Recent tectonics of the Laptev Sea continental margin and its influence on paleoenvironmental changes during the Late Cenozoic

O.D. Naidina, H.A. Bauch. Holocene warmings in Northern Yakutia inferred from palynological records from the Laptev Sea shelf

V.V. Pitulko. The Zhokhov-2000 project: History, research, and results

A. Rudoi. Thermophilic marine fauna in the western Laptev Sea during the Kazantsevo transgression

L. Schirrmeister, D. Oezen, A. Dereviagin, T. Kuznetsova, A. Didenko, K. Burakov. The age of the lowest permafrost deposits on Bol'shoy Lyakhovsky Island - new data from ^{230}Th/U-age determination and paleomagnetic studies

S.R. Verkulich, M.A. Anisimov. Quaternary deposits of Bennett Island (De Long Islands, East Siberian Sea)

Saturday, 14.10.2000

Oral session: Terrestrial/marine interactions in coastal zones

Chairpersons: F.E. Are and H.-W. Hubberten.

09:00 **V. Rachold, M.N. Grigoriev.** Modern and ancient coastal processes in the Laptev Sea region

09 30 **M.N. Grigoriev, V. Rachold, F.E. Are, H.-W. Hubberten, S.O. Razumov, W. Schneider.** Coastal erosion investigation in the Laptev Sea region

09:50 **G. Schwamborn, V. Rachold, M.N. Grigoriev, M. Krbetschek.** Late Quaternary sedimentation history of the Lena delta

10:10 **F. Are, M. Grigoriev, H.-W. Hubberten, V. Rachold, S. Razumov, W. Schneider.** Shore face profiles of Laptev Sea coast

10.30 **M. Antonow, T. Pohl, P.G. Dietrich.** Particle transport of the delta-shelf system of the Laptev Sea

10:50 *Coffee*

Poster session: Terrestrial/marine interactions in coastal zones

11 20 Chairpersons D. Yu. Bolshiyanov and V Rachold Introduction to the poster session Terrestrial/marine interactions in coastal zones

The following poster presentation belonging to this session will be given in the main hall of the AARI Presenters will bein attendance between 11 20 and 13 00

B. Binder. Seasonal distribution of suspended particulate matter versus oceanographic conditions of Laptev Sea shelf waters

D.Yu. Bolshiyanov. Geomorphologic map of the Olenyokskaya Channel mouth in the Lena River delta

T. Müller-Lupp, H.A. Bauch, H. Erlenkeuser. Stable carbon isotope composition of Laptev Sea sediments and its implication for the terrestrial input of organic matter during the Holocene

E.Yu. Pavlova, M.V. Dorojkina, V. Rachold. Reconstruction of the history of development of the Lena River delta in the Late Pleistocene -Holocene based on the geological-geomorphological and morphostructure analyses

V.B. Pogrebov, O.A. Kiyko, V.I. Petrova, T.V. Panteleymonov. Role of natural and anthropogenic environmental factors in the Laptev Sea bottom community structure

V.I. Pozdnyakov. Influence of spring temperature conditions on indices of waterfowl breeding in the Lena delta

C. Röhr, T. Pohl, B. Binder, G. Große, M. Antonow. Coupling the delta-shelf system of the Laptev Sea by GIS Three-dimensional analysis and interpretation of its regional environment

G. Schwamborn, V. Rachold, M.N. Grigoriev, V. Tumskoy. Evolution of Lake Nikolay

V.V. Smirnov, V.P. Shevchenko, R. Stein. Warm fogs over the Laptev Sea

13 00 *Lunch*

14 00 **Internal meetings and workshops**

Abstracts

PELAGIC INVERTEBRATE FAUNA OF THE LAPTEV SEA SHELF

E N Abramova
Lena Delta Reserve, Tiksi, Russia

Zooplankton is an essential component of marine ecosystems playing the leading role in pelagic food chains During the past 10 years the zooplankton of the Laptev Sea has been studied and abundant new data on its composition, distribution, and quantitative characteristics have been accumulated However, a generalization of the material, primarily concerning seasonal changes in the structure of pelagic assemblages, is still lacking

According to the recent data, the pelagic fauna of the Laptev Sea shelf (down to the 100 m isobath) consists of 101 taxa belonging to 10 different types Of these are *Cnidaria* - 10 taxa, *Ctenopora* - 4, *Nemertini* – 1, *Rotifera* – 19, *Annelida* – 2, *Mollusca* – 2, *Arthropoda* – 57, *Chaetognata* – 2, *Echinodermata* – 2, *Tunicata* – 2 Crustaceans (*Arthropoda, Crustacea*) are the most taxonomically diverse among other groups The species composition of *Copepoda* subclass is the highest (50 species), including *Calanoida* – 30 species, *Cyclopoida* – 8 species and *Harpacticoida* – 12 species Fifteen new species of *Copepoda* have recently been reported from the Laptev Sea pelagic regions

The distribution of zooplankton assemblages over the Laptev Sea shelf is primarily controlled by the hydrological conditions of different regions During summer, the planktic assemblages of the Olenek, Tumat, and Yana bays consist of brackish-water and freshwater species, while in winter they are entirely represented by brackish-water ones Typical marine fauna is characteristic of the western Laptev Sea with the dominant assemblage *Oithona similis – Calanus sp – Pseudocalanus minutus* In the central and northeastern parts of the sea a transitional brackishwater-marine complex is formed that is dominated by an *Oithona similis - Pseudocalanus major - Drepanopus bungei* assemblage in the central regions and an *Oithona similis – Acartia longiremis – Pseudocalanus minutus* assemblage in the northeastern ones During winters the share of marine *Copepoda* in the total taxonomic composition decreases while that of brackish-water species increases In the southeastern Laptev Sea brackish-water fauna predominates all the year round

Two peaks of zooplankton abundance have been recorded in the Laptev Sea – one at the end of the winter (March-May) and another one during summer (July-September) Zooplankton abundance experiences considerable seasonal variations During the reproduction period the abundance of organisms could be 50 times higher than after winter The average abundance from year to year could vary by a factor of two The amplitude of seasonal and interannual variations of the zooplankton abundance in a certain region depends upon the life activity of 1-3 mass species, i e the intensity of their reproduction and success of wintering The start abundance of zooplankton at the beginning of the year correlates well with its abundance at the end of summer

In the Laptev Sea the active life period of such mass *Copepoda* species as *Drepanopus bungei, Pseudocalanus major, Oithona similis, Acartia longiremis, Microcalanus pygmaeus* could range from 5 to 9 months Their reproduction period lasts for a long time Some of them are able to produce two generations during a year, one at the end of winter and another one in summer Usually the winter diapause of such species corresponds to the 3-5 copepodite stages

Another group including *Limnocalanus macrurus, Senecella siberica, Jaschnovia tolli* is characterized by a shorter reproduction period (2-3 months) during which they produce only one generation The diapause of these species probably corresponds to the embryonic or larval stages The reproduction of the first two species occurs in winter (December-February), that of *J tolli* at the end of summer

VERTICAL ZOOPLANKTON DISTRIBUTION DURING DAY AND NIGHT TIME IN SEPTEMBER 2000 - PRELIMINARY RESULTS

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[2] Institute for Polar Ecology, Kiel, Germany
[3] GEOMAR Research Center for Marine Geosciences, Kiel, Germany

Backscatter data from two ADCP bottom stations, which were deployed in the Laptev Sea from 1998 until 1999, gave evidence that zooplankton shows a strong diurnal migration This migration was observed during spring (February-June) and fall (September-November), when there was a daylight-night cycle Moreover, this phenomenom was recorded also during the first weeks of both polar day and polar night

Therefore we investigated the difference in zooplankton vertical distribution during night and day with depth during the TRANSDRIFT VIII expedition (25 8-26 9 2000, R/V Yakov Smirnitskiy) We have taken samples at three longterm stations every four hours zooplankton in order to estimate the variability during a diurnal cycle The first results of our investigations will be shown during the workshop

HIGH RESOLUTION LATE HOLOCENE PALEOENVIRONMENTAL RECORDS FROM NIKOLAI LAKE, ARGA ISLAND, LENA RIVER DELTA.

A.A. Andreev[1], G Schwamborn[1], V Rachold[1], M.N Grigoriev[2]
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A new continuous high-resolution lake record from the Lena River delta area provides information about paleoenvironmental changes over the last 7000 radiocarbon yr for this sector of the Arctic

Pollen spectra, radiocarbon-dated to 7000-6000 yr BP, reflect that shrubby tundra with shrub alder (*Alnus fruticosa*) and dwarf birch (*Betula nana*) dominated around the lake at that time The climate was significantly warmer than nowadays Other pollen and plant macrofossil data from the area (Macdonald et al , 2000, Andreev at al , this volume) also support that the warmest climate occurred during that time

The pollen concentration is also a maximum, reflecting high productivity of plant communities on the island These data are in good agreement with the organic carbon concentration of the lake sediments

Between 6000-5000 yr BP a decrease of *Alnus fruticosa* and *Betula nana* pollen and a significant increase of long-distance transported pollen of *Picea obovata*, *Pinus pumila*, and *P sylvestris* mirrors changes in the local vegetation and a decrease of productivity of the plant communities Such deterioration of local climate conditions is probably connected with a rise of the sea level about 5000 yr BP The climate became more marine after that time

Shrub alder communities were probably growing on the island before the end of the Atlantic period Their disappearance from pollen spectra after 4200-4300 yr BP is in good agreement with pollen data from Bykovsky Peninsula, where *Alnus fruticosa* pollen also declined about that time (Andreev at al , this volume) It is interesting to notice that the youngest *Larix* remains found above the modern treeline (Tit-Ary Island area) were also radiocarbon-dated to 4200 yr BP (Macdonald et al , 2000)

The accumulation rate was about 0 25 mm per year during the Atlantic period A relatively high sedimentation rate and pollen data mirror that the climate during that period was the most favorable for the terrestrial and limnic ecosystems

Pollen spectra, radiocarbon-dated to 4000-2000 yr BP, reflect that herb-shrubby tundra with dwarf birch (*Betula nana*) dominated around the lake during the Subboreal period Relatively high amounts of reworked Pinaceae pollen and Encalypta spores (moss growing on disturbed soils) reflect scarce vegetation cover during that time The accumulation rate

was about 0 1 mm per year during the Subboreal period Vegetation cover and climate became similar to modern at the middle of the period

Only 5 cm of sediments were deposited during the last 2000 yr reflecting the very low accumulation rate for that time

VEGETATION AND CLIMATE CHANGES ON BYKOVSKY PENINSULA, LAPTEV SEA COAST, DURING THE LAST 60,000 YEARS BY POLLEN DATA.

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Paleoenvironmental records with associated chronology are rare in the East Siberian sector of the Arctic New pollen and radiocarbon data from Bykovsky Peninsula coastal sections document the Late Pleistocene and Holocene environmental history of the Laptev Sea coast More than 60 AMS and conventional ^{14}C dates indicate that the deposits accumulated during the last 60,000 radiocarbon years

Mostly grass and sedge associations dominated the vegetation earlier than 52,900 yr BP Relatively high amounts of redeposited Pinaceae pollen and Polypodiaceae and *Lycopodium* spores (probably also redeposited), as well as a low concentration of other palynomorphes may reflect a scarce vegetation cover and cold and dry climate

Poaceae and Cyperaceae communities with some *Saxifraga,* Caryophyllaceae, Asteraceae, Cichoriaceae and other herbs dominated in the area between 48,000 and 28,000 yr BP Relatively high amounts of *Artemisia* pollen reflect the presence of steppic biomes in the area Small peaks of *Salix* and *Betula* sect *Nanae* pollen, dated from 48,000 to 36,000 yr BP reflect that climate was relatively warm and wet The high concentration of alga colonies (*Pediastrum*) shows that sedimentation took place in a shallow water environment

The relative decrease of Cyperaceae in the pollen spectra and some increase of Poaceae, Cichoriaceae, and specially *Selaginella rupestris* spores occurred after 28,000 yr BP Low pollen concentration and large amounts of redeposited pollen and spores reflect a scarce vegetation cover or/and low pollen productivity in that time Poaceae associations with some Asteraceae, *Artemisia*, Ranunculaceae, Cichoriaceae, and *Selaginella rupestris* dominated in the site between 28,000 and 10,500 yr BP The climate was much dryer and probably colder than in previous interval

The increase of Cyperaceae and Ericales contents in the samples dated between 15,000 and 13,000 yr BP may reflect a little wetter climate in that time A relatively high amount of *Encalypta* spores is also noticeable in these samples reflecting the existence of disturbed soils in the area

A high concentration of alga remains in almost all samples from the investigated Ice Complex sediments shows that sedimentation took always place in shallow water environment

The Late Glacial/Holocene transition is noticeable by the appearance of tree and shrub pollen (*Betula* sect *Albae*, *B* sect *Nanae*, *Alnus fruticosa*, *Salix*) as well as Ericales pollen The highest tree pollen percentages in the spectra dated from 8320±50 to 4385±40 yr BP reflect that climate conditions were most favorable during that time interval The decrease of the amounts of tree pollen reflects the deterioration of the climate in the Subboreal period Climate and vegetation became similar to modern since that time

FIRST RESULTS OF PALEOGEOGRAPHIC AND CRYOLITHOLOGICAL INVESTIGATIONS ON NEW SIBERIA ISLAND (2000)

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New Siberia Island is second by size in the New Siberian Islands Archipelago Up to now its paleoenvironmental history has been reconstructed after stratigraphic data only, whereas neither cryolithological studies nor absolute dating were done Complex geological, cryolithological, and geomorphological investigations aimed at the reconstruction of paleogeographical conditions were carried out in the southwestern part of the island in 2000

With the exception of small areas of exposed Late Cretaceous and Neogene deposits, the island is formed by Quaternary deposits of different age and genesis According to the previous researchers most common on the island are the Eupleistocene and Middle Pleistocene marine clays, sands, and loams, which form the base of the Quaternary deposits In the southern part of the island they are overlain by Ice Complex and alas deposits

The southwestern part of the island is formed by marine and lagoon deposits with the observable thickness reaching 8 m They are represented by clays overlain by loams and sandy loams with sands and interlayers of allochthonous peat The salinity of the deposits sharply decreases towards their top Very characteristic for the deposits are reticulate and honeycomb cryogenic textures, as well as epigenetic ice wedges of three generations Near the shore these deposits form the surface of the island, while at some distance from the shore they are overlain with remnants of the Ice Complex forming watersheds The thickness of the Ice Complex does not exceed 10 m, they are characterized by syngenetic ice wedges up to 4 m wide Peat deposits (up to 0,5 m thick) are widely spread on the watersheds cut by ravines The Ice Complex expands towards the Wooden Mountains cape and in some places it fills depressions in the roof of marine deposits and it floor lies below sea level Residual-thermokarst mounds are being formed on the area occupied by the Ice Complex Alas deposits fill numerous depressions, the depth of which usually does not exceed 10 m Natural exposures are rare and of small thickness Solifluction processes are intensive and widespread In the region of Rozhin Cape laida is being formed, which is indicative of the rise of area

Nine coastal test-pits made in 2000 enabled us to study marine and lagoon deposits on Rozhin Cape (the southwestern part of the island) and 10 km west of the Wooden Mountains cape Several series of samples for various kind of analyses including radiocarbon dating were taken as well as shells (*Portlandia arctica*) to determine the absolute age of the marine deposits Samples were taken also to determine the oxygen-isotopic composition of the ice wedges Remains of the Mammoth complex fauna were collected

It is planned to continue the works in 2001

ZHOKHOV-2000: GEOGRAPHY, PALEOENVIRONMENT, AND ARCHAEOLOGY

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Zhokhov Island belongs to the De Long Archipelago (the New Siberian Islands) The existence of a prehistoric occupation site on the island became possible due to some peculiarities of its geological history and geographical position The base of the island is formed by basalts, tufas, and argillits dated to the early Cretaceous period Subsequent fluctuations in sea level left a series of terraces on the island surface, the highest of which is correlated with the Senchugovskaya transgression The height of the terrace above present day sea level is 70 m, it is formed by coarse-grained sands with numerous shell fragments Later terraces are 40 m and 10 m high The age of the lowest terrace (laida), which is only 2-4 m high, is ca 4 kyr bp Glacial sediments are not well expressed, while the glacial

forms of relief are represented only by karas observed on hill slopes Numerous but small peatbogs are present on practically all orographic levels Many of them have at the bottom part a layer formed by twigs of *Betula sect Nanae* and *Salix,* the age of which is close to the age of the archaeological site (8-7 kyr bp) These deposits are broken by ice wedges The wedges are 30-40 cm wide, and the fact they are present also in the cultural layer is indicative of a deterioration of the climate in the period after 7 kyr ago At the time of the site appearance sea level was probably 7-10 m lower than it is today The depth in the vicinity of the site exceeds 10 m at a distance of no more than 1 km from the shore Therefore the distance between the site and a possible source of drift wood did not exceed 1,5 km The gradual rise of sea level since the maximum stage of the Sartan Glaciation has led to the formation of insurmountable obstacles for ancient human population migrations The climatic deterioration that occurred simultaneously with the rise of sea level entailed the cessation of peat formation and growth of ice wedges None of the organic/plant remains from the Zhokhov island are dated younger than 6 kyr ago

PARTICLE TRANSPORT OF THE DELTA-SHELF SYSTEM OF THE LAPTEV SEA

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Contributions of B Binder, I Dmitrenko, B Furst, G Grosse, J Holemann, V Rachold, C Rohr

Nearly half a year the Siberian shelf and river areas are monotonously ice-covered due to the arctic winter conditions Vertical as well as lateral processes of particle transport and water movement seem to be at a low level during a complete ice coverage Sediment material becomes incorporated into sea ice by the ice formation (freeze-up) in autumn The onset of the river break-up (and later the melting of sea ice, respectively) allows a rapid increase of particle transport by river run-off to the Arctic Ocean and to the Laptev Sea Sediment dynamics will be intensified and very variable within a short year-by-year "new" arctic spring Then, during the summer period the regular and very dynamic hydrological system of the Lena delta establishes itself as well as the vegetation growth

The permafrost conditions in the ground remain but the mobility of particles of the surface (including the active layer) and a large scale of transport mechanisms leads to a remarkable internal dynamics of the Lena delta region The role of Siberian´s largest delta in the context of mass budget and transfer at the sea-land transition is poorly understood Some results of former investigations do not fit to the puzzle of a regular delta as well as a relic one The main scientific goals of the presented studies are (1) the characterization of the sediment dynamics in the Laptev sea delta-shelf system, (2) the assessment of the contrast between accumulation and erosion of the Lena delta, (3) the registration of the present small scale surficial circulation pattern and the bottom current regime, as well as (4) water level studies, and (5) the estimation of the sediment transport of the main channels of the Lena delta

The mechanisms that mainly force the particle transport within the delta region are (a) fluvial suspension and bedload transport, (b) meander previously of the eastern parts of the Lena delta, (c) gravitative landslides The main processes for the export of particles are (d) tide and resuspension currents along the outer delta, (e) wind induced remobilization along the Lena delta coasts, (f) thermoabrasion, (g) fluvial suspension export and distribution within the shelf area, and (h) the aeolian transport by deflation

The relation of all these processes still needs to be quantified Erosive and transport processes dominate the inner delta, whereas deposition shifts towards the shelf Considering the aspects of observed sediment dynamics the mass balance of the Lena delta seems to be negative The created digital elevation model of this area is the base for the Geographical Information System (GIS) This GIS involves maps and proxy data from field measurements and investigations for a small scale evaluation of the landscape as well as the whole deltaic and marine environments of the Laptev Sea

SHORE FACE PROFILES OF LAPTEV SEA COAST

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Investigations of Laptev Sea shore face profile were continued in 2000 The goals of these investigations were announced at the 5th Workshop During two field seasons a bathimetric survey of 14 profiles 115 km long was carried out off the Laptev Sea continental coast from Taymyr Peninsula to Dm Laptev Strait Furthermore 24 profiles 590 km long were taken from bathimetric maps of 1 25 000 – 1 500 000 scale

Profiles were obtained off (1) erosion shores, composed of loose quaternary deposits, (2) accretion shores of the Lena River delta, and (3) abrasion shores of Taymyr Peninsula, composed of Palaeozoic bedrock The study of profiles confirmed the preliminary inferences made in 1999 and had led to some new conclusions

(1) All shore face profiles of erosion shores are concave, this reveals the nonequilibrium state of the coasts and allows to forecast a continuation of intensive erosion during the next century The position of shore face lower boundary in shallow Laptev Sea is controlled by the level of the inundated shelf surface and is located presumably in the 10-12 m isobath range

(2) A common peculiarity of modern Lena delta shore face is the vast shallow flat bench in its upper part as wide as 20 km The water depths along the outer boundary of the bench usually do not exceed 2 0-2 5 m (bench surface inclination 0 0001) Outside of the bench the sea floor inclination increases sharply to 0 0007-0 0010 Thus the shore face profile as a whole has a convex form and consists of two approximately rectilinear sections with different inclinations In some places a slightly pronounced underwater bar is observed along the outer edge of the bench Similar shallow benches are observed also along the accretion shores in Vankina Guba Bay and in the lakes on Arga Island in the Lena delta

A comparison of the Lena delta shore face profile measured off America-Kuba Island in 1999 with the same profile taken from a bathimetric map of a 1 100 000 scale showed an advance of the delta into the sea for 1 2 km during 25 years This comparison indicates that a bathimetric survey is a promising way for the quantitative evaluation of delta dynamics and sediment balance in a river-sea system

(3) In the area of Cape Tsvetkova on Taymyr Peninsula a very steep cliff about 30 m high, composed of joint Palaeozoic sandstone with conglomerate interbeds and hard coal inclusions, undergoes intensive weathering The shore face profile has the concave form not common for abrasion shores, composed of bedrock Noteworthy is the absence of bench and underwater accretion terrace Such shore face morphology indicates that the sea removes all material coming from the shore and preserves a large inclination of the shore face upper part (0 04) Evidently the Taymyr Peninsula shore in the Cape Tsvetkova area undergoes intensive abrasion and supplies a considerable amount of sediments into the sea

A SYNTHESIS OF THE PALEOENVIRONMENTAL EVOLUTION OF THE LAPTEV SEA SHELF DURING THE HOLOCENE

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Due to lowered global sea-level during the final stage of the last glaciation, the shallow shelves in Arctic Siberia were exposed and subject to terrestrial sedimentation processes Constrained by radiocarbon dates (AMS) sediment cores from the vast Laptev Sea shelf provide new insights into the histories of the circum-arctic sea-level rise since the last glaciation

To reconstruct the Holocene transgression history of the Laptev Sea, a total of 14 sediment cores from the Laptev Sea continental slope and shelf covering a water depth range between 983 m and 21 m were studied The chronology of the cores is based on radiocarbon ages which were dated entirely on marine biogenic calcium carbonate (mostly bivalve shells) The oldest analyzed shell sample in a core from the slope dates back to about 15 5 cal ka, indicating that the covered time period starts before the onset of the meltwater pulse 1A when the global sea-level rose dramatically On the basis of calculated average sedimentation rates a clear transgressional sedimentary pattern is recognized, implying that as sea level rose and the coastline migrated southward, sedimentation rates decreased steeply in a time-transgressive nature from the slope over the broad shelf to the near-coastal region In combination with other sedimentological features, such as the specific ratio of carbon isotopes in the organic matter, the transgressional history was reconstructed The estimates on the inundation history show that the 50 m, 43 m, and 30 m paleoisobaths became flooded at approximately 11 1, 9 8, and 9 cal ka and that Holocene sea-level highstand was reached around 5 cal ka During these time intervals, the sea level in the Laptev Sea rose 5 4 mm/yr, 16 3 mm/yr, and 7 5 mm/year, respectively

Alongside with the general changes in sedimentary pattern, the transgression of the Laptev Sea shelf also led to a significant change in the water mass properties Micropaleontological data based on aquatic fossils clearly document the southward retreat of the riverine freshwater sources (i e , river mouths) during the first half of the Holocene The present day situation of variations in shelf hydrology and sea-ice regime evolved during the last 7 5 cal ka However, the system of riverine freshwater input during the short summer period and the specific ice conditions during winter remained variable also during this time For instance, the temporal distribution patterns of three main ecological groups of diatoms provide crucial evidence for changes in the distribution of pack-ice and fast-ice conditions whereas benthic foraminiferal oxygen isotopes reflect variablity in river discharge

Because of the close land-shelf linkage due to the riverine connections, sediments from the Laptev Sea also give important regional information of the vegetational changes on land Palynological investigations show that the records of pollen and spores in marine shelf deposits closely document the major developments in Holocene climate in northern central Siberia in that the "warmest" phase is recognized between 7 5 and 4 cal ka

DYNAMICS OF CURRENTS IN THE EASTERN LAPTEV SEA IN THE TERMS OF FRACTAL ANALYSIS OF THE ADCP RECORDS

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The vertical structure of currents determines the intensity of vertical fluxes in the water column and the type of vertical exchange through density interfaces The episodic measurements taken at 2-3 horizons during several days gave an idea of the barotropic character of both periodic (tidal) and non-periodic variations of currents on the Siberian shelf However, the baroclinicity of currents in the relatively shallow Eastern Laptev Sea could probably result from the strong density stratification coupled with the bottom morphology

During 1998-1999 within the framework of the "Laptev Sea System 2000" project the yearly records of currents were obtained from the two bottom oceanographic stations equipped with Acoustic Doppler Current Profilers Unlike the previously applied methods, the acoustic profiler records the vertical profile of 3-D current with an interval of 1 5-2 m every minute during the whole year Later the data were averaged for every 30 minutes These data along with CTD measurements carried out during the TRANSDRIFT V (August 1998), TRANSDRIFT VI (May 1999), and TRANSDRIFT VIII (September 1999) expeditions were analyzed in order to study the temporal and vertical structure of currents

The southerly compensatory currents opposite in direction to the wind cause baroclinicity during the ice-free period (Dmitrenko et al , this volume) The shift in current velocity that is observed in the pycnocline below the ice cover is determined by the internal baroclinic semi-diurnal lunar tide M2 (Kirillov et al , this volume) In both cases the strong vertical gradients of current velocity produce shift instability In the terms of structural analysis of turbulence such a movement could be described as the movement over a stochastic attractor with the fractal dimensionality In fact, the scale properties of a series of the correlation integral functions were investigated that is used as a possible estimate of the fractal dimensionality The correlation integrals were calculated for the ice-covered and ice-free water periods (YANA ADCP station) The calculations were performed for 17 horizons spaced at 2-meter intervals from the sea surface to the sea floor It has been found out that during the ice-covered period turbulence in the upper 18-m thick water layer is determined by the location of the pycnocline Thus, during winter time, turbulent fluctuations exist in the water layers affected by the baroclinic semi-diurnal tide currents Estimations for the ice-free period show that fractal dimensionality is present in the water layer between 12 and 28 m, i e , exactly below the pycnocline Thus, turbulence occurs in the upper part of the water layer affected by the baroclinic reversal currents described above

Our results give evidence for the turbulent origin of the baroclinic currents and, hence, the turbulent character of heat exchange through density interfaces Our estimations of the fractal dimensionality allow for evaluating the turbulent fluctuations of velocity during both ice-free and ice-covered periods

SEASONAL DISTRIBUTION OF SUSPENDED PARTICULATE MATTER VERSUS OCEANOGRAPHIC CONDITIONS OF LAPTEV SEA SHELF WATERS

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Contributions of M Antonow, I Dmitrenko, J Holemann

Riverine input, seafloor, and coastal erosion are the major sources of suspended sediment in the water column of the Laptev Sea Especially the Lena delta plays an important role as

a distributor of huge amounts of suspended particulate matter (SPM) This is reflected by a high turbidity in the vicinity of the major river mouths Beside this, biogenic particulate matter, i e , particles resulting from primary and secondary production, is another important constituent of the total suspended matter (TSM) in the water column Thus, in order to understand the transport dynamics of TSM in the Laptev Sea, it is necessary to study the concentration and the spatial and regional distribution of TSM

In order to characterize the transport paths of SPM, the in-situ particle content of the shelf waters was determined during three expeditions at late arctic summer and winter conditions Quantitative data of SPM are presented of 22 stations of the TRANSDRIFT V expedition in August/September 1998, also of 22 sites of the TRANSDRIFT VI winter expedition in April/May 1999 and of 31 locations of the TRANSDRIFT VII expedition during August/September 1999 At every station the water column was sampled at 3 to 7 vertical horizons depending on the water depth and the hydrographic structure The water samples of about 2 litres each were filtered using HVLP-filters by MILLIPORE (0 45 micron)

A total amount of more than 400 single filter data was obtained The lateral and vertical distributions of SPM are presented by the means of Ocean DataView software as well as the GIS program ARCVIEW

The summer situations of 1998 and 1999 are characterized by the dominant outflow of the Lena River Surface SPM content reaches about 9 mg/l during summer 1998 while only about 2 5 mg/l during the late Arctic summer of 1999 The maxima of surficial particles are caused by the riverine input of nutrients (inducing biogenic production) as well as fluvial input of flocculated terrigenious particles The Lena River outflow is evident even in the near-bottom region, but SPM content is much more higher than in the water column above (up to 20 mg/l) In general, the SPM concentration of the bottom nepheloid layer (BNL) decreases towards the north and from east to west during summer time This phenomenon is strongly supported by in-situ observations by means of an underwater camera

The SPM distribution of the winter of 1998/99 differs from the situations discussed above Though the surface content is nearly the same as during summer, the occurance of SPM maxima is controlled by the existence of the Laptev Sea polynya The SPM maximum in the northwestern region is related to strong near-bottom currents within the western part of the polynya The water level of 10 m is mainly influenced by pycnoclines It could be assumed that the relative indifferent occurance of SPM exists due to a more lateral distribution of particles along the hydrographic frontier zones of the medium water column The SPM content is similar to the surface waters of the Laptev Sea shelf region Only the combination of the presented results with acoustic, optical, and biological investigation methods is able to complete our knowledge of the very complex suspension dynamics of the Laptev Sea shelf

GEOMORPHOLOGIC MAP OF THE OLENYOKSKAYA CHANNEL MOUTH IN THE LENA RIVER DELTA

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A geomorphologic map of the Olenyokskaya channel mouth at a 1 100 000 scale is presented that was prepared on the basis of the 2000 field studies

The studies included a geomorphologic survey and investigation of loose deposits comprising the terraces The terrace levels differing in age and genesis were identified using the following criteria geological structure, development of permafrost processes, presence of the ancient channel network components and the absolute height above sea level For this purpose, the direct field observations and an interpretation of aerial photographs were performed

In general, the structure of the massif of islands in the channel mouth is determined by the denudation of the estuary-alluvial deposits accumulated in the Holocene A different time of accretion of these sediments indicates several estuary making cycles occurring in the place of the modern channel and erosion washout stages following them The accretion conditions occurred at the increased level stand of the receiving basin (Laptev Sea) with the washout stages being manifested at the decreased erosion basis The marine terraces at the

heights of 2-4 and 8-12 m mapped in Kuba Bay also indicate the sea level rise in the Holocene

The current river regime determines the structure of alluvial long shore ridges and islets joint to the old delta islands This type of accumulation bodies comprised of sands differs significantly by the sedimentation conditions from the main massif of islands whose deposits were accreted under the conditions of weak flow estuaries The active thermokarst processes that occur continuously during the Holocene change to a great extent the look of the delta islands

The alluvial-marine terrace 30 m high detected in the piedmont area of the Angardam-Tasa mountains (the Tas-Yuryage River mouth) reveals that in the late Pleistocene, the Laptev Sea level fluctuations had a large significance for the formation of the Lena River delta The precise determination of the age of the events described will be undertaken after the radiocarbon analysis of the sediment samples collected from different terraces

POTENTIAL LONG-TERM CO_2-FLUX IN AN ARCTIC TUNDRA ENVIRONMENT

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Results from field experiments in an arctic tundra environment at Samoylov Island have shown extreme high CO_2 fluxes for different soils in August 1999 Individual soils from 5 plots show significantly different patterns for CO_2 evolution rates for individual horizons These pattern show high CO_2 evolution data for the top horizon (e g , a loamy sandy Psammoturbel) and low values in deep layers and reverse orders (e g , Glacic Aquiturbel) These data are extended to a long-term picture by using data from a field station near Tiksi (GAME-Siberia-project), which is located in an environment with comparable soil types Soil properties show similar features like the profile in the loamy sandy Psammoturbel from Samoylov Island The temperature data at Tiksi are recorded at 5 depths (0, 5, 10, 20, 30, and 48 cm) for hourly time intervals from September 1997 to August 1998 The data set is split into temperature intervals of -5 – 0, 0 – 5, 5 – 10, 10 – 15, and >15 centigrades, showing periods for potential microbial activity The time periods of these intervals are used as bases for a CO_2 flux analysis for the individual horizons sampled for soil respiration measurements in August 1999 The results of this combined analysis show a high potential CO_2 flux per area Data from soil physical analyses indicate several constraints for an appropriate CO_2 balance Dominating features for microbial activity are water availability during the freezing process and the frozen state and the changing pore space These figures are suggested as main controlling factors for possible CO_2 production as well as diffusion Hence, the data show a considerable amount of potentially produced CO_2 but actual environmental constraints have to be considered as effective limiting features for CO_2 evaluation

ICHTHYOFAUNA OF THE LAPTEV SEA: COMPOSITION AND STRUCTURE

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In order to estimate the effect of environmental changes on biota, it is important to know the composition of biocenoses Fishes have an important place in biocenoses and play a great role in food chains Many of them are used commercially Meanwhile our knowledge about the fishes of the Laptev Sea is very scarce and is represented mainly by

lists of known species and those collected by expeditions with short comments (Esipov, 1940, Andriashev, 1939, 1948) The general analysis of the marine fish fauna of the Laptev Sea was made by Andriashev (1948) and it is the main paper on this subject up to date The most recent generalized information on fishes of the estuarine and freshwater areas of the region has been presented by Kirillov (1972) The level of our knowledge on the ichthyofauna of the Laptev Sea is still descriptive

In the present publication the composition of the ichthyofauna of the Laptev Sea is revised All existing publications including recent taxonomic revisions are critically studied, scientific and vernacular names are checked Marine, anadromous, semi-anadromous fishes are considered and also those freshwater fishes which occur in deltas and may be recorded in the closest estuarine waters (regularly, rarely, or accidentally)

There are approximately 76 species and subspecies of fishes in the Laptev Sea (including estuarine waters) More than a half (59% or 45 species) are marine forms Three species (*Arctogadus borisovi, Triglopsis quadricornis polaris* and *Liopsetta glacialis*) inhabit both marine and brackish waters One species (*Pungitius pungitius*) inhabits both fresh and brackish waters Sixteen species (21%) occur in fresh waters, rarely entering brackish waters Six forms (*Acipenser baeri chatys, Coregonus autumnalis, C lavaretus pidschian, C muksun, C sardinella sardinella, Stenodus leucichthys nelma*) are semi-anadromous and freshwater ones Three spesies (*Osmerus mordax dentex, Oncorhynchus keta, O gorbusha*) are anadromous *Salvelinus alpinus* is an anadromous and freshwater species

From these *Mallotus villosus catervarius, O keta, O gorbusha, Eleginus gracilis* occur rarely in the Laptev Sea, where the western boundary of their geographical distribution passes

Marine species are mainly benthic or benthopelagic *Clupea pallasii* is nerito-pelagic *Arctogadus glacialis* and *Boreogadus saida* are cryopelagic species

The coastal zone with water of low salinity (15-23‰) to a depth of approximately 9-14 m is inhabited by representatives of an estuarian ichtyocoenosis *Triglopsis quadricornis polaris, Myoxocephalus verrucosus, Lycodes jugoricus, Liopsetta glacialis, Arctogadus borisovi, Gymnocanthus tricuspis* Another group of species occurs in shallow waters below 15-20 m (salinity more than 23-24 ‰) *Lycodes polaris, Gymnelus knipowitschi* (Chernova, 1999), *Icelus spatula, Ulcina olriki, Anisarchus medius, Gymnocanthus tricuspis, Artediellus scaber* The majority of marine species inhabits deeper shelf waters For the greatest depth of the sea only 7 species are known *Raja (Amblyraja) hyperborea, Cottunculus sadko, Careproctus solidus* (Chernova, 1999), *Paraliparis bathybius, Rhodichthys regina, Lycodes frigidus*

No quantitative studies of the marine fish fauna of the Laptev Sea have been conducted and information on each species is presented mostly by a few records The number of known marine species is expected to increase with further study, especially for the deep-sea area

Commercially important are only 10 species *Acipenser baeri, Coregonus autumnalis, C lavaretus pidschjan, C muksun, C nasus, C sardinella, Stenodus leucichthys nelma,* and also *Thymallus arcticus, C peled* and *Esox lucius* All these occur in rivers, estuaries, and closest sea areas Fishery takes place mainly in rivers, to much lesser extent in deltas and estuaries There is no fishery in the open sea

RECENTLY EMERGED MARINE SEDIMENTS ON THE SHORES OF THE HUDSON BAY - A MODERN ANALOG TO CONDITIONS PREVAILING DURING THE LAST MARINE REGRESSION FROM THE LAPTEV SEA SHELF/SIBERIA?

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Subsea permafrost in the Laptev Sea, Siberia, is the result of repeated marine regressions during cold stages, when the worldwide drop of sea level caused the Laptev Sea shelf to fall dry The recent emergence of marine sediments along the shoreline of the

Hudson Bay may be considered as a modern analogue of early Glacial emergence of marine sediments on the Laptev Sea shelf and may provide some potential explanations of permafrost characteristics and features now found on its sea floor

The Universite Laval and BGR cooperate in an extensive field study near Umiujaq/Nunavik, Canada, to observe the cryostratigraphy in epigenetic permafrost that aggraded in marine sediments following land emergence (from isostatic rebound), and to develop numerical models to simulate the observed permafrost processes This work includes the monitoring of the thermal state and the modelling the process of formation of minerogenic palsas and like permafrost mounds

The results of the first field campaign in June/July 2000 will be shortly reviewed with emphasis on the observed rapid development of minerogenic palsas immediately after the emergence of clayey marine sediments Field conditions suggest that the full cycle of palsa growth and decay is completed within a few centuries after land emergence

We present numerical models on the likely permafrost aggradation on the Laptev Sea shelf after a marine regression and on talik formation under an assumed complex river arm system of the Lena river We present arguments in favor of the idea that the numerous crater-like features, tentatively identified as "pock marks", which exist on the sea floor of the Laptev Sea, may in fact be remnants of drowned minerogenic palsas This explanation will be contrasted with other theories (pingo scars, gas blowout craters, iceberg scouring) on the origin of these features

THE RECENT STAGE OF ICE WEDGE FORMATION IN THE REGION OF THE LATE PLEISTOCENE ICE COMPLEX SPREADING (ON EVIDENCE OF ISOTOPIC ANALYSES)

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As of now the Late Pleistocene ice complex is considered a unique archive of paleogeographical and paleoclimatic information One way to obtain and to interpret this information is based on comparison studies of isotopic composition of relict and recent ice wedges In 1998-99 the isotopic composition ($\delta^{18}O$, $\delta^{2}H$, ^{3}H) of both the Late Pleistocene ice complex and recent ice wedges were studied in detail at Bykovsky Peninsula and Bolshoy Liakhovsky Island located in the Laptev Sea basin

The isotopic composition of modern precipitation and active layer were studied also This poster is focused on some features of abundance, cryogenic construction, mechanism of formation, and isotopic composition of recent ice wedges The problem of water movement between earth surface, active layer, and permafrost is discussed More than 150 analyses of isotopic composition ($\delta^{18}O$, $\delta^{2}H$, ^{3}H) are presented

The determination of modern ice wedges is based on the tritium analysis method Tritium, a radioactive component of water, can be used as an indicator of water movement and to examine the "modern water" content in permafrost Modern water with tritium is produced and precipitated out of the atmosphere since 1952, when the first hydrogen bomb was exploded According to the data on tritium analysis, modern (less than 50 years) ice wedge formation occurs widely in this region in different geological units (in some upper part of the ice complex, in alases, logs and terraces)

A further comparing analysis of isotopic composition ($\delta^{18}O$, $\delta^{2}H$, ^{3}H) of recent ice wedges, modern precipitation and active layer water provides insight into the possible mechanism of formation and evolution of the ice wedge system

WIND-FORCED CURRENTS: LINKAGE BETWEEN THE EASTERN LAPTEV SEA AND THE ARCTIC OCEAN?

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Sea currents are one of the most important components of the Laptev Sea environment They are responsible for the vertical and lateral exchange of momentum, salt, heat, suspended particulate matter, and other admixtures It is well known that both thermohaline and wind-forced circulation give rise to sea currents In the Laptev Sea wind-forced deformations of the sea level producing currents are as high as 220 cm However, in most publications dealing with the Laptev Sea circulation they are usually neglected because of their non-periodic character and short duration (compared to the relatively stable thermohaline structure of the sea) The wind-forced circulation manifests itself as intensive bottom currents formed at upwelling that are opposite in direction to the wind In the Arctic such currents have previously been recorded in the Barrow Canyon, Chukchi Sea The presence of southern compensatory currents has previously been expected in the Laptev Sea though no reliable observational data were available

To investigate the water dynamics in the Eastern Laptev Sea, we analyzed the following data 3D-current and echo intensity records from the two Broadband Acoustic Doppler Current Profilers (ADCP) Workhorse 300 kHz bottom stations averaged for every 30 minutes, sea-level and bottom temperature measurements recorded every hour by a bottom CTD deployed at the same localities, daily records of wind and sea level of the polar stations Dunai, Kotel'nyi, Tiksi, satellite RADARSAT ScanSAR images of the Laptev Sea taken twice a month All the data mentioned above were obtained from August 1998 to September 1999 In addition, we analyzed CTD-profiles measured during the TRANSDRIFT V (August 1998), TRANSDRIFT VI (April-May 1999), and TRANSDRIFT VII (August-September 1999) expeditions

The record of the ADCP bottom station deployed in the eastern submarine Lena River valley (about 75°30'N) gives evidence for the presence of strong non-periodic southeasterly currents in the layer underlying the pycnocline Their duration varies from 3 to 7 days The average current velocity is 20-22 cm/s, the maximum one being 59 cm/s These currents recorded 28 times during a year have a great impact on the water circulation in the studied area They are definitely seasonal being absent during winter when the sea ice cover is compacted The ADCP bottom station located northward from the Lena River delta (about 73°30'N) recorded such currents only during winter when the fast ice cover was present We found out that these reversal currents result from the wind-forced deformations of the sea level down to 84 cm The latter are produced by southeasterly winds The currents in the layer underlying the pycnocline are compensatory They are directed opposite to the wind and try to flatten the wind-forced deformations of sea level Thus, the wind-forced barotropic deformations of the sea level are the main factor determining the water circulation in this part of the sea The only question that remains to be answered is why barotropic sea-level oscillations result in such a definite baroclinic reaction of the sea, when reversal currents appear only in the layer underlying the pycnocline

Even during winter the appearance of reversal currents is accompanied by a temperature rise in the bottom water layer by 0 2-0 3°C Hence, the reversal currents are responsible for the advection of relatively warm waters from the north that occurs in the lower water level within the depth range of 30 to 40 meters What it means is that a vertical heat exchange between the atlantic and surface waters exists in the northern Laptev Sea The reversal currents correspond in time with the opening of flaw polynyas in the eastern Laptev Sea during winter The only cause of this phenomenon is southeasterly wind It enlarges the area of ice-free sea surface Wind-forced sea-level deformations of this ice-free surface form compensatory reversal currents in the lower water layer The currents are directed to the southeast They hamper the advection of the shelf high–salinity waters from polynyas

The reversal currents seem to be characteristic for the submarine relic river valleys in the eastern Laptev Sea These sea regions could be considered as the zones of the most active

interaction between the Arctic Ocean and the Laptev Sea under the influence of wind-forced currents

TECTONICS OF THE LAPTEV SEA SHELF AND ITS IMPACT ON MARINE PALEOENVIRONMENT

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The Laptev Sea Shelf (LSS) represents an unique occurrence of a continental margin/spreading axis intersection in the Arctic which is important for addressing the processes of active rifting and its influence on some components of the natural environment The geophysical, primarily multichannel seismic reflection studies of LSS carried out over the last 15 years, revealed a vast rift system whose origin is closely related to opening of the Eurasia oceanic basin This process started about 58 mln yr ago and remained active through the whole Cenozoic time While the structure and seismic stratigraphy of this unique example of oceanic spreading ridge/continental margin intersection are currently well understood, some very important scientific topics still remain highly disputable Among such intriguing questions, the recent and modern tectonics are of great importance *Young tectonic movements represent an important factor of development of the Laptev Sea environment* The fault-related displacements affect the sea-bottom morphology that, in turn, causes a pattern of the near-bottom currents, distribution of water masses, sediment transport paths, and such a specific component of the Laptev Sea natural system as submarine permafrost The latter was probably first generated in response to a drastic cooling related to the opening of the Fram Strait gateway between Greenland and Svalbard and establishing of a deep-sea link between Arctic and Atlantic water masses between ca 10-5 mln yr ago The submarine permafrost was initially discovered by shallow exploration drilling in shallow straits in the archipelago of the New Siberian Islands and then was established by drilling in the eastern part of the shelf during the TRANSDRIFT VIII expedition The published results of numerical modeling of submarine permafrost have shown that the main characteristics of the permafrost as the thickness, continuity/discontinuity, distribution of the talics etc in such an active tectonic setting are structurally controlled The integrated study of the recent tectonic development of the Laptev Sea rifted continental margin, its morphology, sedimentology, permafrost distribution, and sea level changes brings a better understanding of the complex marine environment

GAS INSTEAD OF PERMAFROST? NEW RESULTS FROM HIGH-RESOLUTION SEISMIC INVESTIGATIONS OF NEAR-SURFACE SHELF SEDIMENTS IN THE LAPTEV SEA

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High-resolution seismic (GI-gun) and sediment echosounding (PARASOUND) profiles recorded during the Laptev Sea expedition TRANSDRIFT V were used to interpret and map the lateral distribution and subbottom depth of submarine permafrost The latter was formed during glacial times of lower global sea level when the shelf surface was exposed to very cold air temperatures Thus, permafrost is expected to be found in extended areas of the Laptev Sea except (a) above rift zones where the geothermal heatflow is significantly higher or (b) underneath paleovalleys where the warmer river water prevented the formation of permafrost during glacial times

The interpretation of seismic reflection pattern in combination with results from sediment velocity analysis of high-resolution seismic multi channel data suggests extended areas of unfrozen and partly gas-bearing sediments underneath the paleovalley of the Lena River Near-surface subbottom velocities higher than 1800 m/s, interpreted as indicators for

frozen sediments, are detected in a few small isolated areas only Generally, the top of permafrost is located at or deeper than 70 m below the sea floor which is at least 55 m underneath the base of the Holocene deposits We suggest two explanations for these observations Permafrost was not formed under paleorivers (Lena) during the last glacial maximum and/or permafrost is degrading on the entire Laptev shelf during Holocene times

THE HISTORY OF SEDIMENT TRANSPORT ALONG THE LENA DELTA-LAPTEV SEA SHELF TRANSECT DURING THE LATE PLEISTOCENE-HOLOCENE

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The proposed multidisciplinary OSL project „The History of Sediment Transport along the Lena Delta-Laptev Sea Shelf Transect during the Late Pleistocene-Holocene" concentrates on „Terrestrial/marine interaction in coastal zones", one of the overall research objectives of the „Laptev Sea System Project"

Study aims are

- to compare the main stages of the paleogeographical development of the Lena Delta and adjacent coastal region with the shelf area
- to reconstruct the lithodynamic conditions and the pathways of sediment transport in the Laptev Sea region (along the Lena delta-shelf-ocean transect) depending on the transgressive-regressive cycles over the last 60-70 kyr

In the beginning of 2000, for a detailed reconstruction of the sediment transport in the land-ocean system of the Laptev Sea during the late Pleistocene-Holocene a comparison of marine geophysical and geological data with terrestrial geological, geomorphological, and geocryological information along the transect Lena delta, Laptev Sea shelf, and adjoining deep Arctic Ocean was proposed The study is based on the comprehensive analysis of new and published data on the history of the Lena delta, solid discharge of the rivers, shore dynamics, data on natural outcrops and drill cores, as well as on a seismic-facies analysis The main development stages of the region in respect of its geomorphology, sedimentology, and geocryology will be specified and the character of changes of paleogeographical, paleooceanic, and hydro-lithodynamical conditions for the last 60-70 kyr will be evaluated in detail This may allow us to consider the land-shelf-continental slope interaction as one system of sedimentary material transformation and transport and trace main stages of its history

Main results will be a set of geological, geomorphological maps and paleo-geographical - paleo-ecological schemes for individual time intervals of the Late Pleistocene-Holocene

In the summer of 2000 the authors of the project conducted the terrestrial and marine geological-geomorphological studies in the Lena delta and the adjoining Laptev Sea coast Preliminary geological-geomorphological and morphostructure analysis of the Lena delta and shoreline dynamics, analysis of remote sensing data, and seismic-acoustic data were carried out

Expected results

- Based on the revelation of the regional reference marks fixed in the sections of Quaternary deposits and in seismic-acoustic profiles, the main stages of the paleogeographical development of the selected coastal zone and Laptev Sea sector will be specified
- The lithodynamic situations of mass transfer at the transgressive and regressive stages of the last 60-70 kyr will be updated
- The stages of formation of a paleovalley network on the Laptev Sea shelf in the Late Pleistocene-Holocene will be reconstructed
- The sources of terrigenous material and the main processes of shore evolution will be assessed and the zones of prevailing accumulation and export of sediments from the coastal zone will be evaluated

- The project main deliverables will be a set of maps within the study area (1) Quaternary deposits - 1 2,500,000 scale, (2) geomorphological map - 1 2,500,000-1 500,000 scale, (3) map of shore dynamics - 1 1,000,000 scale

COASTAL EROSION INVESTIGATION IN THE LAPTEV SEA REGION

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During the expedition LENA 1999-2000 studies, within the German-Russian cooperation project "Laptev Sea System 2000", investigations of coastal erosion were carried out on the western and eastern Laptev Sea coast In 2000, coastal studies were conducted along the western Laptev Sea coast, from the Lena delta to Taimyr Peninsula

Studies of coastal erosion of the Laptev Sea have been conducted since the middle of the last century Nevertheless, the role of erosion in this region is still insufficiently investigated So far, nobody can precisely determine what the average long-term and average annual retreat rate of shoreline for the whole Laptev Sea coast is Eroding shores produce a large volume of mineral material incoming to the sea In this connection the analysis of coastal erosion dynamics is a very actual task for the "Laptev Sea System 2000" project

The coastal zone of the Laptev Sea is a representative area for measuring arctic shoreline retreat rates and coastal accumulation processes The length of the continental Laptev Sea shoreline is almost 5000 km About one third of the shoreline consists of an Ice Complex - ice-rich deposits containing massive ice bodies which are subject to active marine erosion and thermal destruction

Coastal erosion is a very important process for the modern and ancient sediment budget of the Laptev Sea The amount of sediments transported by the Siberian rivers is well-known At the same time, the amount of material incoming to the Laptev Sea from the coast has not yet been precisely estimated

The main goal of our investigations was an evaluation of coastal dynamics through two parameters land loss and amount of coastal erosion materials incoming to the Laptev Sea We have studied different types of coasts In more detail, we investigated eroded coast consisting of Quaternary and ice-rich deposits Such types of shores produced the largest volume of mineral material incoming to the Laptev Sea

During the field works we used aerial photographs taken at different times, topographic maps and special geodetic instruments We also used shallow seismic equipment to determine a sub-sea permafrost table position in the near-shore zone and the specific character of sub-sea permafrost transformation To obtain data on the land loss we have compared (1) aerial photographs and maps taken at different times, (2) results of long term monitoring of coastal dynamics, (3) data on field measurements of the up-to-date shoreline position on key sites

In summer 1999, coastline dynamics data were obtained on 12 key sites situated around the Lena delta and further to Dmitry Laptev Strait In summer 2000, the shoreline retreat was studied on 7 key sites situated mainly along the western Laptev Sea coast The results of our coastal studies showed the following

- The shoreline and cliff top retreat along the Eastern Taimyr Peninsula and Kharaulakh Mountain coast is much less then the coastal retreat rate along an Ice Complex, the sandy terrace of the delta, and present-day delta erosive shores
- The maximum erosive retreat rate of investigated coasts belongs to Ice Complex sites (the annual average retreat rate is about 2 2-2 4 m)
- The shoreline retreat rate of small islands, consisting of ice-reach deposits, is almost two times faster than the rate of continental or large islands coast on the key sites
- The shoreline retreat rate of the sandy Lena delta terrace coast is almost comparable with the rate of coasts formed by an Ice Complex
- The obtained data on the average coastal retreat rate allow us to more precisely estimate the volume of coastal mineral material incoming to the Laptev Sea shelf

QUATERNARY SEDIMENTS OF THE SOUTH COAST OF BOL'SHOY LYAKHOVSKY ISLAND

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During July-September 1999 the Arctic expedition „Lena-Delta 1999" was carried out by Russian and German scientists The poster describes the geological-sedimentological situation found by the team when investigating the south coast of Bol'shoy Lyakhovsky Island at the eastern rim of the Laptev Sea The shoreline, formed as a natural coastal cliff some 40 m in height a s l , allowed investigations into the depth without a difficult-to-handle drilling equipment in that far-out area The main goal of this mapping was the lithological and cryological differentiation of the evident Middle to Late Quaternary permafrost formations by field results The classifications were done by color, grain size, sedimentary structures, ice content and ice structures, organic content and carbonate content The poster discusses the 10 different units, which were classified, and their relations to each other in geological space and time The range of differences indicates heavy changes in paleoenvironmental conditions during the formation of the study area

The lowest unit in the outcrop area is a weathering crust of the Precenozoic basement, thought to be of Paleogene age It is covered by a unit of ice-rich permafrost deposits with large ice wedges, peat inclusions, and rock debris This unit was formerly compared with the Olyor suite on the Siberian mainland (Arkhangelov 1996) New U/Th age determinations of peat lenses within this unit indicate an age of 2003 ka BP It is followed by a horizon of two different facies - one subaquatic and one subaerial This horizon was formerly compared with the Kuchchuguy suite on the Siberian mainland (Arkhangelov 1996) Above this horizon the deposits of the Late Pleistocene Ice Complex with large ice wedges are situated The mentioned formations were partially reworked and redeposited by thermokarst and thermoerosion processes in Holocene times So Holocene sediments of subaquatic and subaerial kind have formed in river valleys and alasses (thermokarst depressions), logs (dry thermokarst valleys), and ovrags (ravines) Below the more extended aquatic facies taberites have formed These are permafrost sediments diagenetically changed by thawing in taliks below a lake An active layer of some decimeters of thickness covers the highest parts of all exposed horizons Additionally most of the horizons contain ice wedges or ice wedge casts in different size, quantity and quality, and seggregated ice of different cryostructures

Furthermore, the poster describes the geomorphological phenomena and their erosive causes Thermo-mechanical processes like thermokarst, thermo-erosion, and slope processes play an important role for the morphology in permafrost areas of the Northern Hemisphere periglacial In the outcrop area the most obvious forms were Yedomas (Ice Complex elevations up to 35m a s l of very ice rich sediments with huge ice wedges) that were accompanied by thermo-erosional cirques (wide halfcircle-like niches at the coastal side of the Yedomas) and thermoterraces (gently inclined erosional planes in front of the thermo-erosional cirques with 8-15m a s l) The youngest forms with Holocene age were alasses (extended thermokarst depressions covering areas of up to many km^2 with depths down to 20 m below the surrounding surface), logs (U-shaped, mostly dry thermokarst valleys), ovrags (V-shaped thermo-erosional valleys), and the wide river valley of the Zimov'e

PRELIMINARY RESULTS OF A LITTORAL FAUNA STUDY ON NOVAYA SIBIR ISLAND

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There is little information available on the littoral bottom fauna of the New Siberian shoals Data of composition and distribution of the littoral fauna of Novaya Sibir Island were collected during the international archaeological expedition in August 2000

All specimens were taken in the coastal zone of Ploskiy Cape (75°22'N, 148°37'E), immobilized and preserved in 5% formalin The organisms were examined using the LUMAM luminiscent microscope

In summer (August-September), salinities at the surface coincide with maximum water temperatures (+1-2°C) Maximum salinities (to 28%) occured in March-April The sediments in the study area were predominantly silts and clays

The bottom fauna of the littoral is characterized by the domination of arctic and widely spread boreal-arctic species

The zoobenthos is characterized by relatively high indexes of total quantity and species variety 31 species of macrobenthos were registered The bottom biocenosis of the study area functions in the surface arctic water mass The number of species and the species diversity of the littoral biocenoses in the study area are considerably higher than in the estuary-arctic one

Many small specimens of Polychaeta, Amphipoda (6 species), and fish larves were recorded

With regard to number of specimens, *Mya truncata*, *Tridonta borealis*, *Saduria entomon glacialis*, and *S sabini* were the most important species Among other molluscs *Portlandia siliqua*, *Acrybia islandica*, *Buccinum angulosum*, and *B maltzani* were most abundant

Among empty shells *T borealis*, *M t runcata*, and *Cryptonatica clausa* dominated (30, 21, and 10%, respectively) Seven species of Polychaetes and one of Sipunculids were common, as well as the hydroids *Tubularia indivisa* and the barnacles *Balanus crenatus*

The littoral fauna composition of Novaya Sibir Island was formed under the effect of the interaction of coastal waters freshened by river flow and cold and more saline arctic waters

According to the data received, which is not yet complete, the bottom littoral fauna of Novaya Sibir Island is similar to that of the northern coast of Kotelny Island

TRANSPORT PATHWAYS AND HYDROGRAPHIC CONDITIONS IN THE LAPTEV SEA

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Ten percent of all riverine discharge to the world oceans, in total about 3300 km^3/y, occurs in the Arctic The fresh water is advected from the shelf seas to the Arctic Ocean were it plays a key role in maintaining the Arctic halocline and strongly influences the chemical signature of the Arctic surface water Fluxes of freshwater and dissolved and particulate material from land to ocean integrates changes in the terrestrial ecosystem that are caused by global change Due to strong water mass modification and biogeochemical cycling it appears that the peripheral shelf seas of the Arctic Ocean are key sites for the study and interpretation of this global process

In the Laptev Sea the current regime is the main factor governing heat and salt advection, the vertical exchange through density interfaces, and the transfer of dissolved and particulate matter Extensive studies during different seasons of the year have shown that these processes exhibit a strong seasonal pattern In spring, when the Laptev Sea is still ice covered, the break-up of the river Lena and the strong density stratification are the most important hydrographic features During June alone about 35 percent of the total annual flow of the Lena river and more than 10 million tons of suspended matter flow into the Laptev Sea Due to the intensive density stratification of the water column in the eastern

Laptev Sea, the low salinity water mass and its particulate and dissolved load are transported to the central Laptev Sea nearly without any modification

During the ice-free summer season the transport processes in the central Laptev Sea are mainly wind-forced The pronounced biological activity and the formation of a bottom nepheloid layer are the most important factors controlling transport and the biogeochemical cycling on the shelf River discharge decreases dramatically, but as a result of the high spring discharge of the river Lena and the ice melt, surface waters of the central and eastern Laptev Sea are still characterized by low salinity water masses In contrast, the bottom water in the northwestern Laptev Sea is influenced by the inflow of saline water from the north In the ice-free coastal areas, reworking of seafloor sediments and high biological activity are the major causes for a pronounced layer of high turbidity

The freeze-up of the Laptev Sea is the dominant process in October/November Large amounts of suspended matter are incorporated into the mobile ice cover and could be transported far into the Arctic Basin It could be shown that particulate trace metals like iron are stripped from the ice-bound particulate phase with a subsequent strong enrichment within the dissolved phase This is a unique and important transport process of trace metals which controls the cycling and dissipation of micro-nutrients (like Fe) and toxics (like Pb) in the marine environment of the Arctic

Data from two Broadband Acoustic Doppler Current Profilers (ADCP) and field investigations during two winter/spring expeditions revealed an unexpected hydrographic regime The water column in the polynya region was stratified showing the warmest bottom water temperatures that were recorded during the 13 month observation period We assume that this is a result of upwelling of warmer Atlantic water onto the shelf This heat flux has direct consequences for the ice formation in the polynya region but also for the biogeochemical cycling on the Laptev Sea shelf

WIND-FORCED SEDIMENT TRANSPORT ON THE LAPTEV SEA SHELF

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The main sources of suspended matter in the Laptev Sea, as on most shelf seas, are riverine input, seafloor, and coastal erosion The strong density stratification and the prevailing current regime in the upper water column strongly influence the dissipation of suspended matter from the Lena River to the Laptev Sea because the riverine particles were transported in a low salinity freshwater layer in the upper few meters of the water column within the eastern part of the Laptev Sea During summer and fall the weight concentration of total suspended matter (TSM) and the turbidity in this freshwater layer are high near the delta but strongly decrease at a distance of about 30 to 40 nautical miles off the river mouth Our data indicate that this is caused by a fast settling of TSM of riverine origin and a subsequent formation of a near-bottom nepheloid layer in the coastal area This nepheloid layer is also fed by seafloor and coastal erosion in the shallow parts of the Laptev Sea

The preliminary analysis of the first long-term current and backscatter (a proxy for the concentration of particles) ADCP measurements point to a general northeastward transport of particles in this near bottom nepheloid layer during periods A reversal of this transport pattern could be observed during periods of strong southerly winds Especially during September 1998 and May 1999 strong southward currents with maximum current speeds of more than 60 cm/sec were observed These high current speeds coincide with a pronounced increase of the energy of the backscatter signal near the seafloor and thus indicate a strong resuspension of sediments and a subsequent southward sediment transport

The resuspension of sediments and a wind-forced southward transport in a near bottom nepheloid layer may explain the observed low sediment accumulation rates on the northern shallow (40 to 50 m) shelf and higher accumulation rates in the southern parts of the submarine river valleys and in morphological depressions in the southeastern Laptev Sea During periods of strong northerly winds resuspended sediments are transported across the shallow northern shelf and accumulate in greater water depth on the continental slope

TERRESTRIAL AND OFFSHORE PERMAFROST DISTRIBUTION AND EVOLUTION DURING 400 KYR, LAPTEV SEA REGION

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Onshore permafrost of the region is relatively well known (Geocryology of USSR, 1988) Features of offshore permafrost including the main characteristics like distribution, thickness, topography of the upper boundary, temperature of deposits, subsea taliks origin are poorly known New achievements were made in understanding terrestrial permafrost of coastal lowlands They gave results for the simulation of thaw lake and lake taliks formation on the base of Ice Complex (IC) Obtained results show the existence of only closed lake taliks Thermokarst process started on the emerged shelf and in lowlands at approximately 12 8 Kyr B P (Romanovskii et al , 2000) They play an important role in seafloor formation and lowland topography Lake taliks on the submerged shelf transformed into subsea taliks and created both a complicated seabed topography and an uneven position of the upper boundary of offshore permafrost

The thickness and lower boundary of the IC is under control of neotectonic movements In negative structures the IC lower boundary is situated below the seabed Thaw lakes in the above mentioned neotectonic structures were deep, with the bottom below sea level During the last transgression these lakes transformed into thermokarst lagoons This process simultaneously accelerated the coastal erosion, transformed thermokarst lagoons into traps for sediments, accelerated the rate of sea advance especially after 9-8 Kyr B P , and consistently turned thaw lakes into thermokarst lagoons, and finally, participated the formation of the straits between theNovosibirskye Islands (Romanovskii et al , 2000)

The distribution of offshore permafrost in the Laptev Sea Shelf reaches from the recent coast to the upper part of the continental slope (Romanovskii et al , 1987, 1998) To isobath 40-45 m relic offshore ice-bonded permafrost is continuous Below the 45-50 m the permafrost successively changes to a discontinuous and island one

The simulation of the permafrost thickness evolution during four climatic and glacioeustatic cycles, varying geothermal heat flow - q_{gf} from 40 mW/m^2 up to 70 mW/m^2 show some new, so far unknown permafrost regularities The dynamics of the permafrost thickness formed under geothermal conditions which are typical for rifts (and other equal conditions) show different correlations in thickness at the end of the coldest periods, "cryochrons", and the end of the warmest periods, "thermochrons" The new regularity permits to explain the large differences in permafrost thicknesses in areas with similar paleogeographical conditions both on land and the arctic shelf in tectonic structures with high variations of q_{gf}

The results of the simulations show that up to the isobath 40-45 m relic offshore permafrost was preserved as continuously ice-bonded, impermeable for underground gases and water at least during the last 400 Kyr Permafrost in outer parts of the shelf from the upper boundary of continental slope to isobath 80-75 m disappeared completely during transgression Between these parts of the shelf permafrost was preserved continuously In the outer parts of the shelf there exists a transition zone of temporarily discontinuous permafrost In the latter relic permafrost was preserved during sea water submergence only in tectonic blocks with q_{gf} from 40 mW/m^2 to 50 mW/m^2 Permafrost disappeared completely under conditions of high values q_{gf} of more than 50 mW/ m^2

PRESSURE AND WIND VARIANCE – SPATIAL AND YEAR-TO-YEAR VARIABILITY

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The atmospheric impact is most important for shallow Laptev Sea dynamics, especially if general tidal effects (with a time scale of 1 day less) were eliminated Total variance and

spectral estimations are quite suitable to characterize sea dynamics While temporal and spatial sea level dispersion variabilities are complex as was shown (Ipatov 1999), it is reasonable to compare these results with the same one for synchronously observed pressure and wind data (at the sea surface level)

Initial (pressure, wind) data were measured simultaneously with sea level one at 8 meteorological stations arranged along the Laptev Sea coast line during July-October 1959-1973 The time series were splitted to the 4 bands (30-80 hr, 80-300 hr, 300-720 hr, >720 hr) One difference is the invariant technique being use to analyze vectorial (wind) data According to this approach we have a variance or spectum tensor and therefore estimates of the spatial orientation of the dispersion parallel with signal power

It was revealed that the predominant variances of atmospheric pressure and wind are unstable and correspond to the different time scales mentioned above Generally predominant variance was recorded for such time scales 80-300 hr (1959,1965), 300-720 hr (1961-1962,1971,1973), >720 hr (1960,1963-64,1966,1968-1970) for atmospheric pressure, (1960,1962,1966,1970), (1959), (1961,1965,1972) for wind, respectively

The main features for the seasonally mean variance ratio are for the ratio of oscillation variance within 80-300/30-80 hr – always more than 1 (both pressure and wind), >300/80-300 hr (pressure) too Maximum ratio values areas are at the western part of the coastline (80-300/30-80 hr) and northeastern part (>300/80-300 hr) for the pressure and at the northern and southeastern part of the coastline for the wind, respectively

The main features for variance time series are the variances values within the time scales of 30-80 and 80-300 hr are stable from summer to autumn (probabilities 0 61,0 41 and 0 64,0 47 for atmospheric pressure and wind, respectively), this tendency is most obvious during 1962-64, after 1969 for the first time scale and these probability estimates increase from 1959 to 1973 without 1966-67 for the second one

According to the predominant variance time series tendency character, increased variance segments of time series probability distribution, and the directions of rotation of wind variance it is possible to extract two areas – at the southwest and central (I) and northeast (II) part of the coastline

THE TRANSDRIFT VIII EXPEDITION TO THE LAPTEV SEA: THE SHELF DRILLING CAMPAIGN OF "LAPTEV SEA SYSTEM 2000"

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The Arctic comprises some of the most sensitive elements of the global environment, which are considered to respond rapidly to climate change In this context the Laptev Sea and its Siberian hinterland are of particular interest River discharge into the Laptev Sea constitutes a key source for the Arctic halocline's freshwater budget and the shallow Laptev Sea shelf is a major ice production area, linking the Siberian shelves to the Arctic Ocean and the Nordic seas

During the past years Russian and German scientists systematically investigated the extreme environmental system of the Laptev Sea in the Siberian Arctic to decipher the mechanisms which controlled past climate variations as well as ongoing environmental changes However, our knowledge of the processes which drove the system in the past is still very limited because only a few short sediment cores that penetrated Holocene sequences have been obtained so far

The TRANSDRIFT VIII expedition (20 8 -27 9 2000), the first scientific drilling leg to visit the Siberian Shelf seas, was designed to recover sediment sections in the Cenozoic-age rift system of the eastern Laptev Sea to study Arctic climate changes on time scales beyond the Holocene Because of the shallow water depth of the Laptev Sea shelf, one major

objective of the expedition was to investigate whether past sea-level lowstands caused the development of permafrost also on the shelf For this purpose, the TRANSDRIFT VIII shipboard party cored 5 holes at 3 sites (vibra- and rotary coring) in the northeastern Laptev Sea onboard the Russian drilling vessel NIS KIMBERLIT During the leg, a total length of 40 m of sediments were recovered The sediments show that submarine permafrost exists at two sites already at about 9 m below sea floor Preliminary shipboard results indicate the occurrence of different types of permafrost-affected sediments At all instances, however, ice-bearing and ice-bonded sediments were discovered, verifying for the first time the existence of offshore submarine permafrost in the Arctic Ocean Further investigations will therefore concentrate first on the age and the depositional setting of these frozen shelf deposits

SEISMICITY, HEAT FLOW, AND THEIR ROLE FOR SUBMARINE PERMAFROST STABILITY

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The Laptev Sea is an area of mid-ocean ridge and continent intersection The results from reflection seismic surveys, interpreted by Drachev (1998) and Roeser (1995), seismicity observations, and heat flow measurements put together pieces of a puzzle to understand this intersection

Muller and Jokat (2000) describe submarine volcanism at the Gakkel Ridge and Futterer et al found submarine hydrothermal sites Deeply penetrating seismic surveys revealed fault zones and a pattern of tectonically active lineaments Tectonic activity at the Gakkel Ridge, at the foot of the continental slope, and probably beneath the Laptev Sea shelf is the source of a substantial amount of heat Fault zones must be considered as pathways for heat energy travelling upwards

Thus, it can be expected that the permafrost is incised from above by taliks and from below along tectonic active lineaments

ICE-BONDED AND ICE-BEARING OFFSHORE PERMAFROST ON THE LAPTEV SEA SHELF

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It is well known that freezing and thawing of fine-grained sediment and deposits originate in a range of temperature due to the existence of both free and bonded water in pore media, (General Geocryology Ed V A Kudriavcev, 1978) It is characteristic for both fresh water and saline water, or in other words, for terrestrial and marine deposits Both types of deposits are characteristic for the shelf During sea regression, deposits on the emerged shelf freeze under the impact of a very severe climate and low temperatures During the transgression the frozen deposits on submerged parts of the shelf gradually obtain a temperature close to the mean seabed temperature Under the influence of geothermal heat flux, permafrost thaws upwards from its lower boundary Simultaneously, the temperature profile of perennially frozen deposits gradually increases to a range of freezing- thawing It is possible to divide perennially frozen deposits into two groups ice-bonded permafrost and ice-bearing permafrost Ice-bonded permafrost has temperatures below the temperature range of the freezing-thawing, the deposits are cemented by ground ice, the bonded water content is relatively low Ice-bearing permafrost has temperatures in the range of freezing-thawing The bonded water content in the deposits is high and it changes versus the temperature variation, ground ice in deposits exists in form of crystals, lenses, and small layers, usually separated from each other The physical properties of ice-bearing permafrost depend on ground ice and bonded water content They are changing along with temperature fluctuation

and are transitive between frozen and unfrozen deposits (Frolov, 1998) Freezing/thawing and discharge/recharge of latent heat takes place in all strata of ice-bearing permafrost

The purpose of this paper is to show the approximate distribution of both ice-bearing and ice-bonded permafrost on the Laptev sea shelf A model of permafrost formation and evolution was created taking into consideration the process of freezing-thawing deposits in a range of temperature Calculations have been performed for geological sections which contained two types of deposits silty clay (moisture 30%) from seabed to 10 m depth and sandy loam with a moisture of 25% situated from 10 m to 750 m depth Both types of fine-grained deposits have similar moisture content and different curves of bonded water content versus negative temperatures changing A paleogeographical scenario for the Laptev Sea shelf was used with 4 climatic and glacio-eustatic cycles delivered earlier and published in Russian (Gavrilov et al , 2000) The results of the calculation are preliminary and approximate

For the Laptev shelf a schematic map was compiled in which the following sections of offshore permafrost are shown

- predominantly ice-bearing deposits,
- predominantly ice-bonded deposits and only a thin layer of ice-bearing deposits on a lower part of relic permafrost,
- transitive permafrost section with upper and lower parts with ice-bearing deposits divided by strata of ice-bonded deposits

For the interpretation of seismic profiles in which the boundaries between frozen and unfrozen layers are not evident, these results can be used

PLANTS AS CLIMATIC INDICATORS. - THE POTENTIAL OF PALEOBOTANICAL METHODS EXEMPLIFIED BY MEANS OF THE DATED SEQUENCE OF MAMMONTOVY KHAYATA

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10 well-dated samples from the key section Mammontovy Khayata on the Bykovsky Peninsula were paleobotanically investigated The available age data of the investigated samples prove a continuous sediment and ground ice accumulation during a time interval from about 53,000 a BP until about 3,000 a BP To enable a paleoecological reconstruction of the environmental history of the study area, both palynological and macrofossil studies were carried out

The taxonomical spectrum obtained by macrofossil studies yield different plant communities, which, similar as modern plant sociological records, indicate definite ecological conditions

All Late Pleistocene samples of the studied outcrop reflect mosaic-like distributed vegetation complexes of both notedly dry and wet habitats Most samples even contain species of true water plants from *Potamogetonetalia* Components of tundra steppe communities, mainly from *Kobresio-Dryadetalia*, but also from *Artemisietalia* are particularly representative for the Pleistocene samples Their occurrence was accompanied by the communities *Caricetalia nigrae*, *Scheuchzerietalia* and *Calthion* which prove moister conditions in the depressions The share of xerophilous plants is highest in the oldest time interval of 53,000 - 40,000 yrs BP and during the LGM (about 19 000 yrs BP) and decreases during the interval of 35,000 - 33,000 yrs BP as well as in the Holocene in favour of bog, riperian, and submerse plants

The climatological interpretation of the phytological indications is based on different methods (Ellenberg 1992, Iversen 1944) In Central Europe the evaluation of sites by means of plant indicator values after Ellenberg has been carried out since a long time This method was modified for the implementation in the northeastern Siberian Arctic The comparison of climatic maps with recent areal maps of the determinated species is the basis for the application of climagrams after Iversen In this way it is possible to estimate concrete climate values for the life time of fossil plants, especially for the growing season

While a plant determination on a low taxonomical level is feasible by macrofossil studies, pollen analyses allow chronologically high-resolution insights into the vegetational development of a relatively large catchment area A combination of both paleobotanical

methods makes possible both the quantitative estimate of environmental especially climatical conditions as well as a high-resolution chronology In combination with other paleoclimatical records such as isotope studies of ground ice and paleoentomological investigations, the paleobotanic data are promising concerning the paleoclimatical reconstruction of the Late Quaternery in non-glaciated areas of North Siberia

BAROCLINICITY OF THE CURRENTS AS A CAUSE OF SALINITY VARIATIONS IN THE EASTERN LAPTEV SEA

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Strong vertical density stratification of seawater is an essential feature of the Siberian shelf waters It is assumed that in the eastern Laptev Sea with slight vertical gradients of current velocities and strong density stratification, the vertical turbulent salt exchange is insignificant However, the general increase of the average multiannual salinity of the surface water layer from summer to winter could hardly be explained by the salt extraction at ice formation Our estimations show that salinization caused by ice formation does not exceed 30% The current research is aimed at the investigation of the two other possible causes of the seasonal salinity growth, i e , advection and turbulent salt exchange through the pycnocline with the underlying water layer

The data analyzed included profiles of 3D currents recorded every 30 minutes by two acoustic Doppler profilers deployed in the Eastern Laptev Sea during the time period from August 1998 till September 1999 along with the winter and summer CTD records obtained in the Laptev Sea since 1966 till 1999 Two different processes causing the shift of currents observed in the pycnocline were revealed - the internal baroclinic tidal semi-diurnal waves with a period of 12 4 hours and non-periodic compensatory currents occurring in the bottom water layer The first process is well pronounced during winter below the ice cover, the second one – during summer under open-water conditions The analysis of the vertical shifts of current velocity in the pycnocline shows that turbulent exchange through the pycnocline results from the shift instability of currents These conclusions are confirmed by the fractal analysis of currents recorded near the density interfaces (Berezovskaya et al , this volume)

The dependence between the coefficients of turbulent exchange and the Richardson number was established that gives the most realistic insight into the evolution of salinity profiles from summer to winter To describe this relationship we applied an exponential equation with experimentally selected coefficients For simplicity's sake the salt exchange through the pycnocline was assumed to be vertically constant Its intensity is determined through the average Richardson number in this layer The relationship between the shift instability caused by the processes mentioned above and vertical turbulent salt exchange has been studied The shift of the periodical component of the current velocity (baroclinic semi-diurnal tide) was shown to have a greater impact on the vertical exchange than the shift of the non-periodic component (reversal currents) The ratio between these two components ranges from 3 9 for the ice-free period to 10 2 for the ice-covered period The character of salt exchange considerably differs for the two periods It is expressed by the reduction in intensity of the salt exchange through the pycnocline This is because of the screening effect of the ice cover considerably decreasing the intensity of horizontal movements and shift turbulence Advection only slightly affects the surface salinity, because the average current component is insignificant at both localities Its velocity in the upper layer does not exceed 2 cm/s Thus, not only is the impact of upward turbulent salt flux comparable to that of the salinization due to ice formation, but even exceeds it (by a factor of 2 4 and 4 7 for different stations) From the above follows that the estimation of ice productivity of polynyas from their salinization is incomplete

MODELING OF 3-D WATER CIRCULATION IN THE LAPTEV SEA

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Two moorings with ADCP were deployed for the first time in the Russian Arctic in the shelf zone of the Laptev Sea in 1998 - 1999 within the framework of the Russian-German project „Laptev Sea System 2000" These stations YANA and LENA were located along a submerged relic valley of the Lena River The analysis of the annual observation series has given us a better insight into the mechanism of water circulation in the eastern part of the Laptev Sea

The main objective of this report is to simulate the 3-D current structure in the Laptev Sea by mathematical modeling and to compare calculation results with actual data

In the first set of numerical experiments, currents were calculated using given fields of temperature and salinity and constant wind fields of different directions The results of these calculations demonstrate the appearance of subsurface currents in the regions of relic valleys These currents have directions opposite to those of the surface ones It is a rather important result because such a phenomenon has often been observed in the annual observation series

In the next set of numerical experiments, the currents were calculated using given fields of temperature and salinity and actual atmospheric pressure fields for different synoptic situations of the year 1998 These situations were marked out by processing the actual data

Variations of current velocities for different observation depths and estimates of water fluxes for the surface and near-bottom layers were obtained on the basis of modeling results both for the eastern and western parts of the Laptev Sea A complicated spatial structure of currents is demonstrated and prevailing flux directions are distinguished for different synoptic situations

The calculation results have shown that the model adequately reproduces the main features of the 3-D circulation in the Laptev Sea in synoptical scale and it allows us to turn our attention to reproducing the seasonal ice and hydrological cycles in this region

REPRODUCTION OF THE ARCTIC COPEPOD *CALANUS GLACIALIS* IN THE LAPTEV SEA IN RELATION TO FOOD AVAILABILITY AND ICE COVER

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Abundance and reproductive biology (gonad maturation and egg production) of the arctic copepod *Calanus glacialis* were studied in the Laptev Sea and adjacent Arctic Ocean in September 1993 and from July to September 1995 Both abundance and reproductive activity were subject to strong spatial and seasonal variability, which was related to the ice cover, feeding conditions, and circulation pattern Maximum abundance of the *C glacialis* population was generally confined to the outer shelf and slope with depths between 50 and 1000 m Highest egg production rates and the largest number of young copepodite stages were observed in the eastern Laptev Sea, where the development of the *C glacialis* population seems to follow the opening of the "Siberian polynya" In the western part, which is usually covered by pack ice, the females were all immature and no young stages were found However, the females responded quickly to a temporary opening of the ice there in 1995 and spawned Starvation experiments showed that food-independent reproduction fuelled by internal energy resources was at least partly responsible for high egg production rates at low ambient food concentrations Egg production rates under starvation were considerably higher than reported before

NIVAL LANDSCAPES AND THE ICE COMPLEX FORMATION IN THE LAPTEV SEA COASTAL ZONE

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Field observations in hills around the Laptev Sea (Chekanovsky Ridge, Kharaulakh Mountain, Bol'shoy Lyakhovsky Island, Svyatoy Nos Hills) show the important contribution of nival processes for the surface relief, the hydrological system and the accumulation in this area The nival landscape is considered to be a relatively small area, which corresponds with the

surface relief of nival kars and nival niches and cryoplanation terraces Snow patches were found in each of these forms, which could be considered as places of nivation and other exogenic processes Such exogenic processes are connected, for example, with the growth of algae, mosses and lichens, and other lythophytes near the snow patches and plants on nival meadows Therefore, snow patches are parts of the nival landscape (Chekanovsky Ridge, Kharaulakh Mountain) but nival landscapes can exist also without snow patches for several years (Bol'shoy Lyakovsky Island, Svyatoy Nos Hills) and in general the nival landscape is bigger than the snow patch areas

The studied snow patches have different shapes and sizes of about 100-200 x 50-100 meters and a thickness of more than 2 meters in the central part They are characterized by high contents of fine-grained clastic material (sandy silt, aleurite) and lots of wind-blown plant detritus on the surface The snow patches consist of alternating firn and ice layers of about 5-10 cm thickness Fine-grained clastic material, mosses, and lichens covered the unrounded coarse debris around snow patches Meltwater flows below the debris and therefore we observed subrounded stones and gravels below the surface of debris Furthermore the plant association of nival meadows were studied These meadows were dissected by ice wedge polygons

The recent field observations help us to understand the supposed nival genesis of the Ice Complex formations, which were the typical deposits in the Laptev Sea coastal lowlands during the Late Pleistocene Because of the extremely continental climate conditions during that time the precipitation was too small for the glaciation of large areas of the lowlands in Northeast Siberia We assume, that the frequent occurrence of perennial snow patches and firn fields on the hills and plains around the Laptev Sea could have been an equivalent for the glaciation in West Siberia and Central Yakutia The concept of Ice Complex formation in nival landscapes includes the aeolian accumulation of plant and clastic material on the surface of snow patches, the cryogenic weathering of debris below and around the snow patches, the biogenic destruction of debris by lichens and mosses, and the transport of clastic and organic detritus to the coastal plain areas

THE METHANE CONCENTRATION IN ICE WEDGES OF DIFFERENT GENERATION/THE LENA DELTA

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Field studies of the methane fluxes from ice wedges were carried out during two expeditions in the frame of the "Laptev Sea System 2000" project The investigated sites are located on the different geomorphological levels of the Lena delta (Sardakh, Samoylov, Kurungakh islands) In total, 12 ice wedges were sampled to determine the methane concentration, hydrochemical, and isotope composition Samples were taken in 50 cm intervals along horizontal transects

As known, the age of terrace levels depends on the altitude position in the Lena delta The highest ice complex terrace (Kurangakh Island) was formed during Late Pleistocene The deposits of high flood plain (Sardakh Island) were dated about 3 ka It was found that

the methane concentration from ice wedges of different generations varies significantly Small methane concentrations are observed in ice wedges of the high flood plain, the average value of them is about 300 ppm (the smallest value is 80 ppm) The highest values were obtained from ice wedges of the third terrace, there was the methane concentration more than 3000 ppm (maximum is 4894 ppm) High values (about 2000 ppm) were also obtained from alas deposits of the first terrace (Kurangakh Island) The average value of the methane concentration is about 700 ppm on the first terrace of the Lena delta, Samoylov

In order to obtain the estimation of the total carbon budget in the Lena delta region, it is necessary to take into account the methane emission from ice wedges of different generations A complex data of ice wedges (gas, hydrochemical and isotope composition) can be used for the reconstruction of paleoclimate and ground ice genesis

THE INFLUENCE OF VEGETATION AND SOIL PARAMETERS ON METHANE EMISSION FROM A WET POLYGONAL TUNDRA

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Within the scope of the Expedition LENA 1999, the field work was conducted (72° 22' N, 126° 28' E) in a wet polygonal tundra typical for the Lena Delta, Northern Siberia, on Samoylov Island in August 1999 A considerable part of this study was devoted to the characterization of vegetation and soils of the different sites within the microrelief of a low-centred polygon Soil and vegetation properties were set in relation to CH_4 fluxes Therefore the total and the plant-mediated CH_4 fluxes were measured by means of closed-chamber systems

Distinctly differing soils and vegetation types were found on the elevated rim and in the depressed center of the polygon In spite of the dominance of the sedge *Carex aquatilis* in the whole area of the polygon, the vegetation showed a pronounced zoning along the microtopographical gradient The vegetation of the polygon center was classified as *Meesio triquetris-Caricetum stantis* (Matveyeva 1994), the vegetation of the polygon rim as a transitional type between the associations *Meesio triquetris-caricetum stantis* and *Carici arctisibiricae-Hylocomietum alskini* (Matveyeva 1994) The soils of the polygon center (*Typic Historthels*) were characterized by a water level directly at the soil surface and predominant anaerobic acculumation of organic matter The soils of the polygon rim (*Typic* and *Glacic Aquiturbels*) were characterised by a distinctly deeper water level, lower acculumation of organic matter, and pronounced cryoturbation properties

In the *Historthels* water balance and redox potential as well as content and quality of organic matter were clearly more favourable in regard to CH_4 production than in the *Aquiturbels* of the drier polygon rim The differing ecological characteristics in the centre and on the rim of the polygon were reflected in CH_4 emissions during August 1999 with 25,2 ± 5,1 mg d^{-1} m^{-2}, the total CH_4 emission of the center of the polygon amounted to about five times the total emission on the polygon rim with 5,1 ± 1,5 mg d^{-1} m^{-2}

The CH_4 transport via the aerenchyma of vascular plants was clearly more important to the CH_4 flux in the center than on the rim of the polygon The calculated plant-mediated CH_4 emission accounted for 72 ± 26% of the total CH_4 emission of the center and only for 26 ± 8% of the total emission of the rim of the polygon The stocking density of *Carex aquatilis* and the photosynthetic activity of the vegetation correlated with the total methane emission of the polygon center, while on the rim no correlations could be found These differences could be explained by the composition of the vegetation and the depth distribution of roots in the *Historthels* the water-logged surface horizon was very strongly rooted This dense mat of roots implied an effective uptake and transport of CH_4 by the aerenchyma In the *Aquiturbels*, on the contrary, water-saturated conditions permitting methanogenesis occured not in the strongly rooted surface horizon but in deeper horizons characterized by only few roots

Extensive aerenchyma in roots, rhizomes and leaves of *Carex aquatilis* could be shown by using scanning electron microscopy The aerenchyma in the roots occupied up to 60% of the sectional area, thus allowing an effective transport of gas

The presented results show that the microrelief of a polygonal tundra strongly influences soil and vegetation characteristics and subsequently also CH_4 fluxes

PLEISTOCENE DEPOSITS AND INSECTS OF BOL'SHOY LYAKHOVSKY ISLAND (PRELIMINARY DATA)

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Until recent times fossil insects of the New Siberian Islands were very poorly known from a few isolated ones However, the region of the New Siberian Islands is very important for understanding the history of the high arctic landscapes, because the most northern of the known Pleistocene outcrops are located here During the field work of the Russian-German expedition in 1999, twenty-five samples with insect fossils were collected All the stratigraphic horizons were sampled, starting with the „Olyor", the age of which is considered as the Early Pleistocene, and ending with the „Yedoma" deposits of the Late Pleistocene age All the names, used here for the local stratigraphic units, are preliminary

The deposits, provisionally referred to as the Olyor Suite, are exposed in several points at the base of the coastal cliff to the west from the camp (near the Zimov'e river mouth) They are represented by clay silts with inclusions of unrounded boulders and peat lenses Of the six samples taken from the „Olyor", two contain enough insect fossils for the analysis Both assemblages contain mostly tundra insects, the mesic tundra species dominate, while those characteristic of typical and arctic tundra are abundant enough In one of the samples, single fossils of insects of the steppe group are found Evidently, by the time of accumulation of the „Olyor" deposits, tundra-steppe landscapes already existed in this area In general, the „Olyor" insect assemblages indicate severe environment Higher, with the notable break in sedimentation, a uniform formation of relatively less icy sandy silt lies, provisionally labelled as the „Kuchchuguy Suite" Two facies of „Kuchchuguy" deposits are distinguished – subaquatic and subaerial units The age of these deposits is not clear at the moment, it is either the Middle or the beginning of the Late Pleistocene Five samples were screened from the „subaerial Kuchchuguy", and three from the subaquatic one In each of the samples fossil insects occur in small numbers, but of nearly the same composition We found it possible to join several samples of the „subaerial Kuchchuguy" in one assemblage In comparison with „Olyor" in the „Kuchchuguy" assemblages, the xerophylic tundra species dominate while the share of mesophylic, typical, and arctic tundra insects decreases The insects of sedge heath, very common for tundra-steppe assemblages, play a notable role in the „Kuchchuguy" (6,5 %) Tundra-steppe environment with a strong tundra component is reconstructed, with a less humid climate than in the „Olyor" time

Above the „subaquatic Kuchchuguy", a silt unit lies, provisionally named „Krest-Yuryakh Suite", which is peculiar for two horizons of ice wedge pseudomorphs The pseudomorphs are filled with the plant detritus, with abundant insect fossils We took four samples from two sites (east and west of the camp) In each case, both pseudomorph horizons were sampled All the four samples have a similar composition, a small variation can be explained by random reasons Mesophylic tundra species dominate in the assemblages with a notable contribution of aquatic, riparian, meadow, shrub, and other insects, that in general is characteristic of the entomofaunas of the southern shrub tundra On the other hand, the „Krest-Yuryakh" insect fauna shows the very important role (up to 22%) of species, characteristic of the tundra-steppe assemblages (steppe, meadow-steppe, and sedge heath) Fossil insect assemblages with pronounced steppe component are very typical of the Pleistocene of Northern Asia, but in the units with large ice-wedge casts the share of the steppe group is usually lower than in the underlying and overlying deposits A possible parallel to the „Krest-Yuryakh" insect fauna should be looked for in the Achchagyy Suite assemblages (Kaplina et al , 1980), underlying the Middle Pleistocene Ice Complex in the Lower Indigirka area Surprisingly, we have not found a higher percentage of steppe

insects below and above the „Krest-Yuryakh", which may in the future invite interesting paleoecological explanations

A silt unit with huge ice wedges – Ice Complex or the „Yedoma" formation – builds the top of the Pleistocene succession on Bol'shoy Lyakhovsky Island This unit is of Late Pleistocene age In total, six samples were screened from this unit, only three of them being sufficient for statistics The insect assemblages are of tundra type, with xerophylic tundra species dominating the two lower samples, and some increase of mesophylic species in the upper sample An important role of modern inhabitants of typical and arctic tundra is revealed, but almost no fossils of the steppe group At present, the Lyakhovsky Ice Complex insect assemblages are not typical for the other Late Pleistocene successions with strong steppe and sedge heath components But this record is very scarce as compared with the much more detailed Bykovsky one and chronologically does probably not include the stages, revealed in the Bykovsky section

In general, the studied Pleistocene insect assemblages of Bol'shoy Lyakhovsky Island demonstrate a lower role of the steppe component than in the mainland sections, which may be related to the northern position of the sites If confirmed, this feature can probably be used for certain inferences about the past climate

PERMAFROST DEPOSITS AS ARCHIVES FOR PALEOCLIMATE AND PALEOENVIRONMENT - EXPEDITION TO THE OLENYOKSKAYA CHANNEL, 2000

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In summer 2000 a group of Russian and German scientists continued the study of the Middle and Upper Quaternary permafrost deposits at the Olenyokskaya Channel In order to complete former studies (in 1998) of other groups in the framework of "Laptev Sea System 2000", two sections were studied The first study area is located in the western Lena delta near the settlement Nagym 5 km off the river cliff (Kyuryuelyakh Sise Island) and the second object is located in the central Lena delta at the location Buor Khaya 5 km off the cliffs (Kurungnakh Island)

All studied sections were divided into four units The first unit is a light brown to yellowish sand with single gravel layers in lower parts of the cliffs In the lowest meters this horizon is characterized by many vertically orientated grass roots and allochthonous peat horizons The content of grass roots increases with height The upper meters seem to be free of plant remains Additional narrow and short ice wedges, low ice contents (20-30 %), and a massive cryostructure are typical Deposits seem to belong to a flood plain facies They were provisionally named as "Bulukur Suite"

The Late Pleistocene Ice Complex with a clear boundary follows this suite A cryoturbated paleosol horizon is obviously at the boundary between the sandy suite and the Ice Complex The Ice Complex deposits consist of grey sandy sediments with many peat inclusions and repeated paleosol horizons This unit is characterised by high ice contents (50-100 %), reticulated cryostructures, and large ice wedges

The third probably Holocene unit on the top of the sections consists of silty sands with peat inclusion and paleosols and contains narrow ice wedges (0 5 m wide) of several generations The forth unit could be an alluvial sandy series with allochthonous peat horizons This unit was probably formed in a terrace facies and seems to have a Holocene age and contains large remains of alder and birch wood as well as large ice wedges (2-3 m wide)

The main topics of our fieldwork reflect the multidisciplinary character of the research

- Geological and cryolithological mapping and facies differentiation of deposits,
- Sampling of frozen sediments and measurement of ice contents,

- Sampling for age determination (conventional and AMS radiocarbon dating, Optical Stimulated Luminescence dating, U/Th-dating),
- Sampling of typical ice wedges for isotope and hydrochemistry analysis,
- Collection of fossil bones,
- Screening of sediments for rodents and insect studies
- Sampling for seed analyses, determination and collection of recent tundra vegetation and beetles,

The paleontological mammalian collection contains bones of woolly mammoth (two modifications), horses, reindeer, bison, and hares During fieldwork we screened more than 700 kg of sediments for rodents and for the first time we found rodents teeth *in situ* in the first unit

This expedition to the Olenyokskaya Channel continues the study of the permafrost deposits on the Bykovsky Peninsula and on Big Lyakhovsky Island Our multidisciplinary approach to the study deposits gives the possibility to compare genesis, paleoclimatic and paleoenvironmental conditions in different parts of the Laptev Sea region

CLIMATIC TRENDS IN THE LATE QUATERNARY AS DEDUCED FROM ICE WEDGES OF NORTHERN SIBERIA

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The best archive for paleoclimatic studies in polar regions is glacier ice Vast areas of Northern Siberia are lowlands without any Pleistocene and actual glaciation Instead of glacier ice cores, our studies focus on the paleoclimatic and paleoenvironmental reconstruction of Late Quaternary very ice-rich permafrost sequences being a part of the Russian-German multidisciplinary research program "Paleoclimate signals in ice-rich permafrost"

They are based on a detailed sampling of ice wedges for hydrogen and oxygen isotope as well as hydrochemical analyses Ice wedges reaching heights of up to 40 m are perspective study objects covering probably more than 60 ka Big ice wedges mostly grow syngenetically to sedimentation and are principally formed by frost cracking and freezing of meltwater of winter precipitation Thus, ice wedges may reflect mean annual winter temperatures, which can be ascertained by the stable isotope method The application of hydrogen and oxygen isotopes for paleoclimate studies in ice bodies is well known as one of the best tools for paleotemperature reconstruction and for identifying a source of precipitation Especially the combination of H and O isotopes has so far only rarely been applied to ground ice being a considerable extension of the method

Different generations of ice wedges were sampled, distinguished by means of their characteristic shape, color, size, and position in the outcrop The results of two expeditions to different locations (Bykovsky Peninsula and Bol'shoy Lyakhovsky Island) in the Laptev Sea Region (LSR) show changes in the climatic character throughout time indicating differences in winter temperatures, humidity, and continentality A gradient of the ground ice evolution for the LSR can be observed

STABLE CARBON ISOTOPE COMPOSITION OF LAPTEV SEA SEDIMENTS AND ITS IMPLICATION FOR THE TERRESTRIAL INPUT OF ORGANIC MATTER DURING THE HOLOCENE

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Stable carbon isotope ratios in the organic fraction of the surface sediments and sediment cores from the Laptev Sea shelf were analyzed in order to study the modern distributional pattern of terrestrial organic carbon and to reconstruct the terrestrial input during the Holocene The stable carbon isotope composition of the surface sediments ranges from -26 6 ‰ PDB near the coastal margin to –22 8 ‰ in the north towards the outer shelf The lightest values of $\delta^{13}C_{org}$ occur near the mouths of the Lena, Yana, and Olenek rivers, suggesting a high riverine input of terrestrial organic matter The low $\delta^{13}C_{org}$ signature gradually declines northward and along the submarine river valleys Characterizing possible sources of organic matter by their stable carbon isotope composition reveals that the terrestrial influence reaches further north in the eastern than in the western Laptev Sea

Downcore studies of the $\delta^{13}C_{org}$ and TOC records, measured on AMS ^{14}C-dated marine sediment cores from water depths between 42 m and 60 m, specify the spatial and temporal changes in the deposition of the terrestrial organic matter on the mid shelf during the past 12 7 kyr Due to the postglacial sea level rise, the Laptev Sea shelf became widely flooded This process caused large-scale coastal erosion with an increasing dispersal of terrestrial organic matter on the shelf areas The major depositional changes of terrestrial organic matter occurred between 11 and 7 ka and comprised the main phase of the southward retreat of the coastline and of the river depocenters during the postglacial transgression Decreasing TOC accumulation rates and a significant increase of $\delta^{13}C_{org}$ on the central shelf at 7 ka marks the onset of a transition towards decreasing depositon of terrestrial organic matter After this time the sea level reached its Holocene maximum and, as a consequence, the main depocenters of the rivers moved their position southward, leading to the modern depositional environment

MODERN AND PALEOENVIRONMENTAL CYCLICITY IN THE EASTERN LAPTEV SEA AS SHOWN IN STABLE ISOTOPE PROFILES FROM SHELLS OF LIVING AND FOSSIL BIVALVES

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At three stations in the eastern Laptev Sea stable oxygen and carbon isotope profiles from shells of the modern bivalve specimens *Astarte borealis* and *Macoma calcarea* were established in order to reconstruct the short-term environmental changes in the strongly coupled land-shelf system of the Laptev Sea The detailed sampling of a shell valve along its axis of maximum growth provides an isotopic record of environmental and physiological changes during the lifetime of the specimen The oxygen isotopic profiles of the bivalves exhibit a cyclicity reflecting the annual cycles of hydrographical and hence ecological conditions Regarding the well-known relationship between carbonate $\delta^{18}O$, temperature, and isotopic composition of water, it is possible to identify phases of isotopically lighter $\delta^{18}O$ values indicating summer and heavier $\delta^{18}O$ values indicating winter season

conditions Because all modern bivalves were collected alive, calendar years may be addressed directly by counting the annual isotope cycles backwards from the margin As the $\delta^{18}O$ and $\delta^{13}C$ cycles along a growth axis of the bivalves shell correspond to the seasonal hydrographic changes they can be compared with synoptical oceanographic data from previous years

The main forcing factor of the $\delta^{18}O$ cycles of the shell carbonate is the variation of the isotopic composition of the bottom water Measurements of $\delta^{18}O$ in surface and bottom waters of the Laptev Sea show a linear relation of salinity and water $\delta^{18}O$ with a coefficient of 0 6 ‰/psu The effect of water temperature on the $\delta^{18}O$ of calcite precipitation is about –0 25 ‰/°K and thus exerts a minor influence on the annual isotope variation because the temperature data from seafloor and bottom water measurements show a comparatively low annual variability of ± 0 3–0 5° K

Carbon isotope profiles from all specimens show decreasing values in springtime sections probably related to the river break-up and seasonal phytoplankton productivity Trends towards lighter $\delta^{13}C$ values through ontogeny suggest the effects of metabolic changes from a juvenile state into a mature adult

Given the cyclicity in modern bivalves, stable isotope profiles of fossil, AMS-dated, and well preserved bivalve shells from sediment cores may address the temporal variation, in particular the seasonality of hydrographic settings and their changes during the transgressional history of the Laptev Sea

FREEZING INDUCED CHANGES OF MECHANICAL PROPERTIES IN PERMAFROST AFFECTED SOILS

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A soil system is a combination of solid material, liquids, and gases The solid materials of various geometries form the soil skeleton, interspersed with voids These voids – the soil pores – contain liquids, gases, ice, or a mixture of all The moisture within the soil plays a major role for soil properties and processes associated with phase change The freezing temperature of the soil water is determined by the soil matrix, particle size, content of organic material, and the composition of the soil water and varies from soil to soil

Composition and structure of soils as well as conditions of freezing determine water transfer and ice formation in the soil and therefore the developing pressure during freezing Freezing of a soil can produce an effective stress and consequently a consolidation of the soil matrix This effective stress originates from the suction developed in the pore water and an elevated pressure of the ice Therefore, compressible soils may consist of consolidated aggregates, separated by ice lenses or other forms of segregated ice Coarse-grained soils show practically no liquid moisture migration during freezing and the vapour transfer is not sufficient for the formation of segregated ice The determination of the unfrozen water content during freezing and in frozen soils was performed by a general phase composition equation on the basis of the specific surface area of the soil

Tests carried out in the laboratories of the University of Kiel help to predict freezing induced changes of the soil properties A sandy clay loam and a loamy sand (Samoylov Island) are used in an experimental set-up which enables mono- and bi-directional freezing of structured and unstructured soil cores (706 cm) The tests consist of three freeze-thaw cycles, each at a different reference temperature (-5°C, -10°C, and –15°C), and last for 5 to 6 weeks The thermal regime, changes of the unfrozen water content, and the stress state of the soil are logged automatically in time steps of 10 minutes

The recorded pressure, in dependence on the soil water/ice content and the soil composition, enables us to predict freezing induced changes of soil properties This information is needed for a better characterization of stress situations in the habitat of soil microbes

CONSTRAINTS FOR SOIL MICROBIOLOGY ACTIVITY AND SOIL PROPERTIES IN AN ARCTIC TUNDRA ENVIRONMENT

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Abiotic factors control soil processes as well as soil microbiological properties Temperature is one of the most evident stresses in cold regions but varies especially in the ground locally with specific conditions These influences are modified by processes occurring in the boundary layer of snow, vegetation, and accumulated organic material As such the mean annual air temperature differs by several degrees from the mean annual soil temperature Similarly soil microclimates depend on soil composition, structure, and water content, e g , snow can react as an insulator for the ground and this is the principal reason why the mean annual ground temperature can be many degrees warmer than the mean annual air temperature During summer free water on and in the ground represented by melted water cannot drain due to the underlying permafrost It poses special constraints for microorganisms, as the thermal conductivity of the soil varies with moisture content

All these parameters define not only the actual living space of the soil microbes but also the annual soil properties A rapid drop of the soil winter temperature is necessary to cause cracking, and this is impeded by an insulation snow cover Soil water content at the time of freeze back influences not only the expansion forces in the ground but also the amount of meltwater in the following summer When coarse-grained soils thaw, the water can drain relatively freely The absence of excess ice minimizes pore water pressures and there will be little loss of strength and little soil movement Meltwater has a bigger influence on frost susceptible soils Due to frost heave and ice segregation and with unfrozen water several degrees below 0°C, thawing can involve a loss of strength and the process of consolidation, with influence on the pore system

With the data collected during the Lena-Delta expeditions in 1998 and 1999 and with the data maintained by the GAME project, we have knowledge of the snow cover in spring, the annual soil thermal regime and the hydrologic regime in the active layer With the help of this information we can predict soil properties and therefore the habitat of soil microbes

RECENT TECTONICS OF THE LAPTEV SEA CONTINENTAL MARGIN AND ITS INFLUENCE ON PALEOENVIRONMENTAL CHANGES DURING THE LATE CENOZOIC

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Basically the Cenozoic development of the Central Arctic continental margin was controlled by progressive penetration of processes of riftogenesis and spreading from the North Atlantic into the Norwegian-Greenland and Eurasian basins, which constrained the contrasting character of tectonic movements at the adjacent shelf The moderate recent subsidence of Eastern Arctic Russian seas shelves has led to very smooth relief at the shallowest (up to 60-80 m) shelf The recent tectonics of the Laptev Sea shelf were controlled by the penetration of continental riftogenesis processes from the mid ocean Gakkel Ridge into continental margin influencing the forming of the continental grabens system crossing the whole shelf The real "explosion" of tectonic activity in the beginning of Quaternary time controlled sumaltenous growth of mountains which seems to be the main reason of initial glaciations in the Northern hemisphere Glacial processes occured asynchronously in various parts of Russian Arctic continental margins During vast sheet glaciations on Barents and probably Western Kara Seas shelves extremely severe cold and especially dry climatic conditions took place on the exposed areas of the Laptev Seas shelf,

due to such paleoenvironments glaciers were absent there and thick enough (up to several hundreds of meters) permafrost was formed on the shelf

The Pliocene-Quaternary cover is composed by arenaceous-argillaceous, mostly marine and glacial-influenced marine deposits Sparker records, single channel seismic data, coring and shallow drillings (from the fast ice) in bays of the mainland and in the straits between the New Siberian Islands suggest that the thickness of the Pliocene-Quaternary veneer is commonly 50-250 m on the Laptev Sea shelf In the Late Cenozoic period continental slopes of the Central Arctic Russian continental margin experienced progradation due to the intensive activity of suspension flows and forming of fan deposits up to 1-2 km thick

The last neotectonic rearrangement was accompanied by a glacio-eustatic regression and the last glaciation Its extent, estimated by different authors, is either different from or wholly incompatible with the model of a pan-Arctic glacier covering almost all Arctic shelves in Russia The elevations of marine terraces in the Russian Arctic indicate that glacio-isostatic movements subside towards the east of the region, where the last glaciation was minimal At the Late Pleistocene-Holocene stage, intense crustal subsidences in peripheral deep-sea grabens and glacio-isostatic coastal uplifts accomplished the formation of the present-day morphostructural pattern in the Central Arctic transition zone The contemporary seismicity of continental slopes and rift grabens is the evidence for persisting tectonic activity of the transition zone The maximum of recent tectonic activity on the Central Arctic Russian continental margin was confined to the coastal belt where uplifting involved Byrranga orogen and Verkchoyansk, Chersky ranges as well as the peripheral shelf uplift along the New Siberian Island Archipelago and Vrangel Island These processes were accompanied by high-magnitude, differential, primarily downward crustal movement that occured during the early stage of the continental margin evolution and were caused by the dependence of recent tectonic conditions in the Arctic transition zone on the processes of rifting and spreading in the Arctic Ocean The last one is the youngest segment of the world ocean and this fact contains one of the possible explanations of the unique character of recent tectonic movements on the Russian Arctic continental margins The average amplitude of recent tectonic subsidence of the Central Arctic Russian Seas shelves is evaluated as –200 metres

HOLOCENE WARMINGS IN NORTHERN YAKUTIA INFERRED FROM PALYNOLOGICAL RECORDS FROM THE LAPTEV SEA SHELF

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Radiocarbon-dated sediment cores from the Laptev Sea were analyzed in order to investigate the Holocene climate changes in the high Arctic on the basis of the dynamics in vegetation and marine-fluvial depositional environments This study gives a first detailed account on the land-ocean linkage in northern Yakutia on the basis of pollen data Palynological investigations were carried out using sediment cores samples obtained from the Khatanga-Anabar river channel in the western Laptev Sea and from the submerged Yana valley in the eastern part of the sea The temporal fluctuations in the pollen and spore records give clear evidence of climate-induced changing environments during the Holocene

On the basis of the derived pollen assemblage zones, the entire time interval was interpreted into three climatic periods I (10 6 to 8 6 ka BP) - apperance of xerophytic grass, *Artemisia* and Chenopodiaceae pollen may indicate reduced humidity and development of coastal biotop The presence of *Betula exilis* and *Alnaster fruticosus* pollen indicates warming as well as northward migration of the arboreal vegetation, II (8 6 to 4 4 ka BP) - in the beginning, this period was dominated by sedges and mosses and characterized by cold and wet conditions The highest values of arboreal pollen of *Pinus pumila* in the interval between 7 3 to 4 4 ka BP indicate the general warming during the Holocene The high content of pollen indicative for long-distance influx, including a single grain of *Tilia*, may corroborate that their source areas were much nearer to the study area now than before, III

(4 4 ka BP to present) reflects a time when mosses and sedges became widespread and environments typical for tundra and Arctic deserts were established

Palynological records indicate that the warmest conditions occurred in the Boreal (10 6-8 6 ka BP) and in the Atlantic periods (7 3-4 4 ka BP) This interpretation confirms interpretations based on terrestrial pollen data showing that during the Early Holocene the climate in the high Arctic was relatively warm However, a comparison of pollen records shows that marine pollen records clearly reveal only the increase in the arboreal component in the mid-Holocene signifying warming (Naidina et al , 2000, Naidina and Bauch, in press) During the time following the climatic optimum (early Subboreal) a typical shrub tundra vegetation existed in the adjacent Siberian hinterland whereas the Arctic deserts and tundra dominated by mosses and sedges became widespread in more recent time

ACOUSTIC SIGNATURES FROM THE LAPTEV SEA SUBMARINE PERMAFROST - PHYSICAL STATE AND STABILITY IN HOLOCENE TIMES

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Acoustic investigations of the Laptev Sea shelf were carried out during Polarstern expeditions ARK-IX/4, XI/1, XIV/1b (TRANSDRIFT V) and TRANSDRIFT VIII using high-resolution echosounding (PARASOUND), high-resolution multi-channel seismic (GI-guns) and core logging techniques (Multi-Sensor-Core Logging) The morphological structures identified in PARASOUND profiles in the Laptev Sea are similar to typical permafrost features on land These include pingos, thermokarst, and ice complexes If not exposed at the sea floor, these permafrost features are draped by a relatively thin (mostly about 2 to 6 m) cover of unconsolidated Holocene muds Permafrost features are also located in the paleovalleys of the Lena and Yana rivers This suggests widespread permafrost soil formation during Quaternary glacial periods when the Laptev Sea was exposed to very cold air temperatures In contrast, the analysis of multi-channel seismic data of the TRANSDRIFT V expedition reveal velocities of up to 1800 m/s for the top 70 m of the sediments which are significantly lower than the velocities of ice bonded permafrost observed elsewhere This suggests that the top 70 m of the Laptev Sea sediments are characterized by ice-bearing or even unfrozen ground today Only below 70 m subbottom velocities are similar to those from field measurements in solid permafrost Data from the TRANSDRIFT VIII drilling results are consistent with the seismic interpretation In the cores of the top 20 m, ice-bearing layers alternate with unfrozen sediments The latter have velocities of 1550 to 1850 m/s which are in the same order of magnitude as velocities in the top 6 m of the sediments (Vp 1450 to 1800 m/s) cored from the Laptev Sea during previous expeditions The data suggest two different interpretations (i) During glacial times the permafrost formation in the Laptev Sea was characterized by ice-bearing rather than ice-bounded ground Solid permafrost is rare and found only locally (e g , in pingo structures) (ii) During glacial times the permafrost formation in the Laptev Sea was characterized by ice-bearing ground which is affected by degradation during Holocene times Morphological features observed today may only be relicts of formerly solid permafrost (pseudomorphs) Locally there is evidence of sedimentary gas in the Laptev Sea sediments as indicated by diffraction hyperbolae in seismic and PARASOUND profiles The formation and migration of sedimentary gas may be caused and controlled by the degradation of permafrost

THE MODELING OF THE NUTRIENT FLUXES AT THE LAPTEV SEA BOUNDARIES.

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Based on the data recently obtained in the joint Russian-German expeditions, the present state and evolution of the Laptev Sea ecosystem are evaluated The main tool to

interpret the collected data and understand the hydrological regime is the mathematical modelling of the hydrochemical processes For this purpose we worked out the balance model of the hydrochemical processes Based on the balance hydrochemical model of the Laptev Sea, the average multiannual fluxes of nutrients and carbon at the sea boundaries are evaluated The average influx of silicon with river runoff to the Laptev Sea reaches 2 0x106 tons, that of nitrates - 2 0x103 tons, phosphates - 2 5x103 tons, and carbon - 3 0x103 tons The influx from the Arctic Ocean through the northern boundary (78oC) is 5 5x107 tons for silicon, 4 0x106 tons for nitrates, and 1 3x107 tons for phosphates From the above follows that river runoff has a 3%-share in the total balance of nutrients while the rest of 97% of nutrients is brought to the sea through its northern boundary

EARLY HOLOCENE ENVIRONMENT AND ECONOMY IN THE LAPTEV SEA REGION: A PRELIMINARY VIEW FROM ZHOKHOV ISLAND

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Zhokhov Island (76° 06'N, 152° 42'E) lies northeast of the New Siberian Island group in the Laptev Sea During the past summer, members of the research project "Zhokhov 2000" conducted excavations at the well-known Zhokhov archaeological site and sampled several geological localities to collect a variety of paleoenvironmental data Previous research and the preliminary results of this year's efforts indicate that the people who lived on Zhokhov some 7800 years ago had an economic orientation characterized by the exploitation of polar bear (*Ursus maritimus)* and reindeer (*Rangifer tarandus)*, with avian fauna comprising a relatively minor part of their diet This highly specialized and narrowly focused adaptive strategy appears unlike any ethnographically described examples from the North American or Eurasian Arctic It was apparently a recurrent seasonal phenomenon and may have been motivated by opportunities to trade bear parts (e g , skins) to the south

Significantly, such a strategy would be impossible on Zhokhov under the environmental regime that prevails at present None of these species except the polar bear are found there today Indications from faunal remains found in the archaeological site and plant macrofossils found at several geological localities on the island are that environmental conditions were once significantly warmer than at present While we are beginning to understand these environmental differences, that understanding is currently far from complete The extent of the Zhokhov land mass and its proximity to the New Siberian Islands, the mouth of the Lena River, and the Eurasian mainland in the early Holocene are unclear and make environmental reconstruction uncertain Drawing on the preliminary results of this year's research, this paper will discuss our current understanding of early Holocene human - environmental interaction on Zhokhov Island, and will outline areas where further research is needed

THE ROLE OF THE NEOTECTONIC MOVEMENTS IN THE FORMATION OF PERMAFROST THICKNESS

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In the regions of permafrost occurrence, there are some permafrost thickness anomalies, that cannot be explained from the position of the classic point of view pof ermafrost formation For example such anomalies are noted in the Magadan region in an area with discontinuities of permafrost (Basisty et al 1993) These anomalies can be explained by the influence of vertical neotectonic movement Such movements are typical for the rift zones (Ust'-Lena rift) and regions with modern glacier-isostatic elevation (Canadian shield) in areas with continuities of permafrost

The mathematical modeling of the evolution of permafrost thickness was made with the help of a new program There were established two variants of temperature dynamics on the earth surface (upper boundary condition) The first one stationary temperature condition (-2--20°C), the second one sinusoidal temperature dynamic the period of 100 Kyr and a different amplitude of temperature variation It corresponds to the boundary condition of the first type The time interval was 300 000-500 000 years (3-5 long-term climatic cycles) On the lower boundary of the model (depth = 2 km) there were established the conditions of the second type (geothermal flow 40 and 70 mW/m^2) The calculations were made for model calibration The results of simulation are preliminary

In the model it was stipulated compensatory sedimentation (speed of the moving block is equal to sedimentation or denudation rates) and the speed of the moving block has a constant value The calculations were made for four rates of subsiding and accumulation of deposits 0,5, 1,0, 5,0, 10,0 mm/year As the result we obtain that due to block rate subsiding 0,5 mm/year anomalies of permafrost thickness are approximately 5% Due to the rate of velocity 10 mm/year anomalies of the permafrost thickness are approximately 30%

The anomalies values of permafrost thickness are not equal to the value of vertical block movement The analyses of the calculation allow us to conclude that due to the block rate of 1 mm/year and more the influence of neotectonic movements on the permafrost thickness formation is a very important factor They should be taken into account on both the Laptev sea shelf and the coastal lowlands

SEASONAL AND LONG-TERM VARIABILITY OF THE SEA LEVEL IN THE MARGINAL SEAS OF THE ARCTIC OCEAN

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The basic problem of climatic monitoring of the Arctic Ocean is the choice of the most representative predictors of large-scale variability One such parameter is the sea level of the Arctic Ocean, integrating practically all static and dynamic processes in the hydrosphere and atmosphere of the Arctic Mean monthly sea level data at 44 coastal and island stations in the Kara, Laptev, East Siberian, and Chukchi Seas in the years 1950 - 1990 were used to analyse the seasonal and interannual variability Sea level has a significant annual cycle The magnitude (from peak to peak) of the intraannual sea level variability in the coastal zone of the Arctic seas is 20 - 30 cm on average

The analysis of interannual and interdecadal changes has shown that at practically all stations of the Kara, Laptev, East-Siberian, and Chukchi seas in the period from the beginning of the 50's until the 90's there is a steady increase of sea level On average for a coastal zone of the Siberian shelf the sea level in the 80's was 5 - 6 cm higher than in the previous decades

The excellent agreement between observed decadal mean values of the sea level and the results of diagnostic simulations gives grounds to believe that the tendency of rise of the sea level in the Arctic Seas is connected with the change of the thermohaline condition and reorganisation of large-scale water circulation of the Arctic Ocean, rather than lowering of the coasts of the Arctic Seas, as was suggested previously

RECONSTRUCTION OF THE HISTORY OF DEVELOPMENT OF THE LENA RIVER DELTA IN THE LATE PLEISTOCENE-HOLOCENE BASED ON THE GEOLOGICAL-GEOMORPHOLOGICAL AND MORPHOSTRUCTURAL ANALYSES

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Based on field observations during the „Lena-98-2000" expeditions, the interpretation of aerial photography, and the analysis of our own collected and published data on the sections of Quaternary deposits, several geomorphological levels are identified in the Lena River delta They include a low and a high floodplain (with absolute heights of 1-4 m and 4-8 5 m, respectively) of current and Late Holocene age, respectively, the first above the floodplain accumulative terrace (9-12 m) of the Early Middle Holocene age, the second above the floodplain cocle terrace (13-29 m) of the early Holocene age, and the third above the flood plain cocle terrace (30-60 m) of the Late Pleistocene age These terrace levels have a different spatial extent within the Lena delta The western delta sector is characterized by the development of the entire terrace complex In the eastern part of the delta, only two floodplain levels and relics of the third above the floodplain level are observed

In order to reveal the morphostructural features of the Lena delta to determine the tectonic structure and the character of the tectonic development of the region, a morphostructural analysis of the territory was undertaken Based on processing the cartographic and aerial photography materials, a map of rose-diagrams of lineaments and a map of lineament density were prepared An analysis of the obtained maps made it possible to delineate several areas within the Lena delta, each of them having its own typical direction of the main rays of rose diagrams of lineaments and lineament density values

The use of a large amount of own and published data on radiocarbon dating of Quaternary deposits allows us to speak objectively about the delta relief formation stages

A combined geological-geomorphological and morphostructural analysis made it possible to draw some preliminary conclusions about the tectonic development of the region and the changes of the Lena delta hydrographic network during the Late Pleistocene-Holocene

LOW-FREQUENCY WAVE PERTURBATIONS IN THE FIELD OF CURRENTS IN THE LAPTEV AND EAST SIBERIAN SEAS

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The current variability of synoptic scale at different horizons at 3 moorings deployed at the continental slopes of the Laptev and East-Siberian seas and the Lomonosov Ridge in 1995-1996 are examined These current meter data were kindly given to one of the authors by Dr Woodgate from the Polar Science Center, Applied Physics Laboratory, University of Washington, Seattle

The statistical analysis of the daily mean currents includes a calculation of different invariants of variance tensor, the estimate of two-dimensional probability densities of current velocity vectors, and the computation of various invariants of the spectral and cross-spectral of tensor-function It is revealed that tensor curves of summarized current variations are ellipses The principal axes of these ellipses are generally aligned with the bottom topography The analysis of the two-dimensional probability densities of current velocity vectors show the two-mode structure with opposite direction of currents which is characteristic to wave motions The autospectra of daily mean current time series reveal clear peaks at the periods of 120, 48, 27, 15, 11, 7 5, and 6 7 days With increasing depth, a coherence between current perturbations is decreased with an increase of phase lags It is indicated that the revealed current perturbations are baroclinic A cross-spectral analysis show that these current perturbations propagate southeastward in the form of progressive

waves with phase speeds of about 18 – 40 cm/s and have lengths 350 – 600 km A comparison of the obtained parameters of the wave perturbations with theoretical dispersion relations of low-frequency waves indicates that they are close to the phase speeds of the baroclinic Kelvin waves A cross-correlation analysis between wave current perturbations and different meteorological parameters (air pressure, horizontal gradient air pressure, wind, divergence and rotor of wind) indicates low values of maximum correlation coefficients (0 17-0 35) An analysis of the daily mean fields of atmospheric pressure shows that the most intensive wave current perturbations (magnitudes of 30-33 cm/s) were generated when an anticyclone was located in the region of 3 current meter moorings and then began to be displaced slowly to the southeast with a velocity close to the phase speeds of the revealed wave perturbations It is possible to hypothesize that the revealed wave current perturbations are generated due to a resonance between the atmospheric disturbances and free internal Kelvin waves

METHANE FLUX STUDIES IN SIBERIA – CONCLUSION AND OPEN QUESTIONS ABOUT THE IMPACT OF CLIMATE CHANGE ON PERMAFROST SOILS

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The main environmental and climate changes are expected for the permafrost regions, where nearly 27 % of the world soil carbon are stored Possible changes will be risen temperatures, changed distribution of precipitation, and atmospheric perturbation, increased flooding, risen groundwater, and sea level fluctuations The presented soil carbon studies are focussed on methane emissions of permafrost soils of different Siberian sites Methanogenesis is one important part of the so called methane cycle, which controls the main processes of the global carbon cycle like the regulation of the anaerobic C decay, accumulation of soil organic matter, and the leading back of soil carbon to the bio-, hydro-, and atmosphere The summer emission rates of methane range between 10 and 160 mg $CH_4 * d^{-1} * m^{-2}$ while the carbon dioxide fluxes reach maximum values of 4400 mg $CO_2 * d^{-1} * m^{-2}$ from typical wet polygon tundra sites (Taimyr Peninsula, Lena delta, Kolyma Lowland) The main distinguished parameters are soil temperature and soil moisture regimes that are mainly depending on soil organic carbon, vegetation cover, and micro relief Estimations for the summer period show that only 1 to 4% of soil organic matter is released as methane carbon The methane production near the zero temperatures (-0,6°C to +1 2°C) in the anoxic horizons of wet Gelisols demonstrate a distinct methane formation during the re-freezing time of the year Nearly 25% of the annual fluxes are captured in the upper frozen parts of Gelisols, which will be released during thawing periods Methane oxidation – with maximum values of about 55 mg $CH_4 * d^{-1} * m^{-2}$ in the polygon centers – is one major process controlling the methane release from the polygon tundra Methanotrophic bacteria oxidize about 50-70% of the methane produced in anoxic layers The results of the methane fluxes are used to estimate the impact of environmental and climatic changes on permafrost-affected soils Possible effects are 1) interactions with the carbon and nitrogen cycle, 2) changes in biomass production, 3) effects on pedogenic oxides and clay mineral formation, 4) effects on soil erosion, 5) changes of the soil water regime and 6) effects on the biocenosis

THE ZHOKHOV-2000 PROJECT: HISTORY, RESEARCH, AND RESULTS

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The islands of the De Long Archipelago are a very remote, isolated area which is difficult to access, and they are completely desert nowadays Zhokhov Island is one of the fife islands of the archipelago It is situated under 76° NL

The site has been known since 1967, when I Ye Zhidkov, a mechanic operator from the Zhokhov weather station, have gathered a few artifacts in the southernwest section of Zhokhov Island However the first chance to excavate the site was in 1989 The excavations were supported by the Arctic and Antarctic Research Institute as a part of the interdisciplinary project conducted on the De Long Archipelago in 1987, 1989, and in 1990

The site excavated for two years was found to be of the most ancient in the whole Arctic It has a unique preservation of diverse organics (bones, artifacts, etc) Bone, wood, and charcoal specimens were carbon-dated in three laboratories That gives a solid background for the dating of the site The dates obtained independently have a good correlation, and, what is very important, there are close correlations between dates obtained from different organics (bone, wood) A single date of charcoals deviates from the medium The dates belong mainly to the interval from 7,800 to 8,000 BP (non-calibrated age meanings) In that way, the age of the site could be dated to that time, i e , to the Early Holocene A few deviations took place but their appearence could not be explained by a presence of some unrecognized ancient cultural components because they are older than the LU 2502 sample coming from the underlying stratum No peculiarities of spatial distribution of the dates are found so far Since the Zhokhov site was excavated in 1989/90 we still keep working on the collection This is one of the oldest sites in the Arctic, but is it the oldest one?

Studies done on the material show a very specific type of subsistence strategy based on polar bear hunting The assemblage has a good cultural relation with the mainland but they look to be very general A blade technology discovered from the site appears to be almost identical to assemblages known in Eastern Chukotka These sites represent the early Holocene arctic cultural tradition which has an extension in Alaska

The project Zhokhov-2000, which is currently running, gives new information on the site and related topics such as paleogeography, environmental history, and the cultural development of the area

ANNUAL AND INTERANNUAL VARIABILITY OF NUTRIENTS IN THE LAPTEV SEA

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The Laptev Sea is a region with highly variable physical processes and high and variable rates of primary production and organic matter recycling Dissolved inorganic nutrients (nitrate, phosphate and silicate) are the mineral basis for lower trophic level organisms and they are important components of the Laptev Sea system The main goal of the report is to show some results of multiyear studies of nutrients distributions in the Laptev Sea within the framework of the Russian-German project "Laptev Sea System"

The studies are based upon the data set obtained during the unique TRANSDRIFT expeditions and AARI's archive data set The Ocean Data View software (AWI, R Schlitzer) was used to gather all available data The ultimate product of this work is a large, consistently high-quality data set of nutrient measurements that can be used as quantitative constraints for coastal hydrochemical models

The Laptev Sea is significantly influenced by fresh water and suspended matter input from rivers The fluvial impact on nutrient cycling is considerable in the southeastern part of the sea Physical processes like mixing and complex circulation patterns control the nutrient variability Stratification hinders the upward flux of nutrients into the mixed layer The annual cycle of nutrients depends on ice conditions (fast ice, polynyas, drift ice, and

marginal zone) and the salt distillation effects of freezing and thawing Biological processes are very active during the short summer in the Arctic There are similar regions in the Laptev Sea where phosphate, nitrate, and silicate probably limit the primary production Biochemical processes produce mineral nutrients continuously during the year but the intensity of the processes seasonally depends on temperature and changes As a result of the physical and biogeochemical processes, nutrient cycling and the seasonal reconstruction of the water column have some regional features in the Laptev Sea

The year-to-year variability of nutrients in the Laptev Sea depends on internal and external processes in the system The most important factors that control the variability are hydrometeorological conditions in the deep Arctic Basin

ROLE OF NATURAL AND ANTHROPOGENIC ENVIRONMENTAL FACTORS IN THE LAPTEV SEA BOTTOM COMMUNITY STRUCTURE

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The main objective of the presented contribution is to reveal the environmental factors determining the composition and structure of the study area benthos Data are collected in the course of the Russian-American cruise Marine and Estuarine Ecosystems of the Russian Arctic - 95 aboard RV *Yakov Smirnitsky* during August-September 1995 Water, seabed sediments, and benthos are studied in the following areas 1 – offshore of Severnaya Zemlya and the Novosibirskiye Islands archipelagos, 2 – mouth areas of Khatanga, Lena, and Yana rivers, 3 – Vilkitsky, Sannikov and Dm Laptev straits, 4 – area of one of the main ports along the Northern Sea Route – Tiksi The complete list of recorded abiotic characteristics includes more than 60 variables Benthos sampling is carried out at a depth from 7 to 50 m at 24 sites (total of 156 samples is collected) Mathematical data analysis is accomplished on the base of the software package *PRIMER* worked out by Plymouth Marine Laboratory (UK, package BioEnv) and an original software package of Group Method of Data Handling Algorithm (self-organizing method in modelling) Links of bottom community characteristics with the environment are assessed separately for macro-, meio- and microbenthos

Hydrological and chemical characteristics in the near-bottom water varied within the following limits temperature - -1 2-6 7∞C, salinity - 11-32 3‰, water transparency D - 5-85%, pH – 7 00-7 85, levels of various substances O_2 - 59-103% of saturation, NO_2 - 0-0 001 mg N l^{-1}, NO_3 - 0-0 05 mg N l^{-1}, NH_4 - 0-0 26 mg N l^{-1}, Si - 0-0 95 mg Si l^{-1}, Fe_{tot} - 0-0 09 mg Fe l^{-1}, particulate organic matter - 0 60-4 38 mg C l^{-1} Seabed sediments were represented by all varieties from polymixtite to clay (analysis by 13 fractions) with a median grain size of 0 007-0 275 mm (silt predominated) and a sorting coefficient of 1 15-5 39 Levels of quartz, feldspar, and silt minerals in seabed sediments comprised 5-50, 5-25 and 10-88%, respectively The content of carbonate carbon in sediments (here and below - per dry weight of specimen, %) was 0 01-0 54, organic carbon - 0 27-7 90, organic matter (OM) - 0 49-14 38, chloroform extract from OM - 0 01-0 60, alcohol-benzol extract from OM - 0 01-0 15, humic acids - 0 05-2 74, total hydrocarbons - 0 001-0 120, aliphatic hydrocarbons - 0 0007-0 0735, polyaromatic hydrocarbons - 0 0001-0 0462, pitches - 0 008-0 376, asphaltens - 0 001-0 124 The levels of metals in the clay fraction of sediments (ppm) varied within the following limits Zr- 72-210, Ba -300-900, Cu - 23-120, Cr - 35-84, Co - 6-50, Ga- 7-20, Mn - 380-5600, Ni - 36-76, Pb - 20-110, Sr - 100-400, Ti - 3000-5600, V - 86-240, Zn - 200-2500, Y - 14-37, Sc - 10-28, Cd - 5-78 Radionuclides in sediments were represented within the following limits (Bq kg^{-1}) ^{137}Cs - 0-26, ^{40}K - 383-700, ^{228}Th - 6-54, ^{226}Ra - 4-59

239 species and groups of macrobenthos, 17 taxa of meiobenthos (mainly of the order-class level), 4 species of microbenthic Ciliophora are identified The biomass of macrobenthos comprised 0 1-296 0 g m^{-2}, of meiobenthos - 0 3-27 1 g m^{-2}, abundance of microbenthos - 0-19 individuals cm^{-3}

It is shown that benthic community composition and structure are determined by both natural and anthropogenic environmental factors The list of these factors, correlation between biotic and abiotic variables and other details on the results of multivariate data analysis (BioEnv procedure and self-organising modelling) will be discussed in the course of presentation

SEA-ICE AND HYDROLOGICAL CONDITIONS IN THE LAPTEV SEA DURING THE PAST 9000: EVIDENCE FROM DIATOM ASSEMBLAGES

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Based on diatom assemblages distribution and detailed chronological control, the first attempt was made to reconstruct the short-term changes of riverine runoff and their influence on the hydrology and sea ice conditions in the Laptev Sea during the past 9000 years The established linkage between relative abundance of freshwater and sea-ice diatoms in the surface sediment assemblages and surface water salinity, sea-ice and sedimenthological regimes within the inner Laptev and Kara seas influenced by the great Siberian rivers was used for reconstructing salinity fluctuations

In order to establish modern proxy tools for paleoenvironmental reconstructions, surface sediment diatom assemblages were studied in the inner parts of the Laptev and Kara shelves The composition of diatom assemblages from the surface sediments of the Laptev and Kara seas shows a significant relation to the general hydrological conditions (Cremer, 1999, Polyakova, 1999) The relative abundance of the group of freshwater diatoms clearly follows the general pattern seen in surface water salinity (Bauch et al , 2000, Dmitrenko et al , 1999, Pivovarov et al , 1999) whereas other groups, such as the sea-ice diatoms, are related to the distribution of the drifting pack ice, which extends to the north of the winter fast-ice edge in the Laptev and Kara seas (Bauch and Polyakova, in press, Polyakova, 1999, Dmitrenko et al , 1998) An extremly high concentration of diatom valves, dominantly freshwater species, in the surface sediments from the Ob (up to 54 7 mill Lvalves/g) and Yenisey (up to 71 5 mill valves/g) estuaries corresponds to an average summer salinity ranging between 2 and 5 This zone of intermixing of riverine waters and seawaters is specified by "avalanche-like precipitation" of riverine organic matter due to active coagulation and flocculation (Lisitzin, 1995, 1999)

Our reconstructions of the paleoenvironmental development during the past 9000 yrs in the Laptev Sea were set on diatom distribution patterns and the detailed chronostratigraphy of core PS51/92-12, which was obtained to the northeast of the Lena delta On the basis of the presented results, the following paleoenvironmental events in the Holocene history of the Laptev Sea can be emphasized (1) due to gradual sea-level rise under the Holocene transgression the studied area was flooded by 9 0 ka BP, when sea level was raised up to the modern isobath of about 30 m The time span of 9 0-8 6 was characterized by "alavanche-like precipitation" of riverine diatoms under a salinity between 5 and 2, (2) during the time interval of 8 6-7 5 ka BP the water salinity in the investigation area increased up to 8-10 due to the southward migration of the Lena River delta, (3) the following time interval (7 5-5 0 ka BP) with an overall decrease of relative abundance of freshwater diatoms indicates transition of marine conditions with salinity of 14 and larger typical for the modern hydrological conditions of the investigation area, (4) since 5 6 ka the study area was under the influence of drift ice, and drift ice edge and polynya migrated near its modern position The notable southward shift of the polynya area and drift ice edge is marked out for the time interval of 5 2-3 2 ka that was possible caused by the increase of summer riverine runoff

INFLUENCE OF SPRING TEMPERATURE CONDITIONS ON INDICES OF WATERFOWL BREEDING IN THE LENA DELTA

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The study of the influence of environmental factors on the condition of waterfowl populations is one of the main tasks of the monitoring program for bird populations in the Lena delta The environmental factors which influence at the first stages of breeding period are very important for the forecasting of bird breeding success In this presentation the dependence of some breeding indices of model species of waterfowl on the temperature conditions during the beginning of the nesting period in 1994 - 2000 is considered

Bewick's Swan *(Cygnus bewickii)* Index of breeding - average size of brood (ASB) Period of the beginning of breeding from May 21 till June 10 ASB was the least (2,5 chicks) in the year with lowest average temperature in the period of the beginning of breeding (TBB) (-6,2°C, 1996) and the greatest (4,2 chicks) in the year with greatest temperature TBB (3,3°C, 2000) In years with negative TBB (1996 - 1998) ASB did not exceed 3 chicks

Brent Goose *(Branta bernicla)* Index of breeding - date of first egg lay (DFE) Period of the beginning of breeding - first half of June Earliest DFE (June 4 and 7) is recorded in years with highest TBB (6,2°C, 1995 and 6,4°C, 1999) Latest DFE (June 19) is recorded the lowest TBB (-3,0°C, 1996)

Steller's Eider *(Polysticta stelleri)* Index of breeding — density of nesting* (DN) Period of the beginning of breeding - first half of June The dependence of breeding index from TBB is expressed less precisely than for the previous species Nevertheless, greatest DN (7,3 and 10,7 pair/km^2) is recorded in the years with greatest TBB (1995, 1999)

Thus, TBB is an important factor influencing the breeding success of waterfowl and this index is necessary to be taken into account for the forecasting of breeding success

MODERN AND ANCIENT COASTAL PROCESSES IN THE LAPTEV SEA REGION

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Contributions of M Antonow, F Are, D Bolshiyanov, M Doroshkina, H -W Hubberten, M Krbetschek, E Pavlova, S Rasumov, E Reimnitz, W Schneider, G Schwamborn, S Solomon, V Tumskoy

Shore dynamics directly reflecting the complicated land-ocean interactions play an important role in the balance of sediments, organic carbon and nutrients in the Arctic Basin Formerly the rivers were considered as the main suppliers of sediments into the World Ocean The results of more recent investigations however showed that sediment input to the Arctic shelf resulting from erosion of ice-rich, permafrost-dominated coastlines may be equal to or greater than the input from river discharge

In order to understand the sediment budget of the Laptev Sea, several investigations in the Lena delta and the Laptev Sea coastal region have been carried out during the last three years The objectives were

1 to understand the sedimentation history of the Lena delta and its role as a modern and fossil accumulation area and
2 to quantify sediment input to the Laptev Sea through coastal erosion

To decipher the sedimentation and environmental history of the Lena delta, different geomorphologic, geological, and geophysical approaches have been applied at selected locations The age control of delta sediments is based on AMS ^{14}C and OSL At several key sections along the Laptev Sea coast geodetic measurements were performed on land to obtain the modern position of the shores Shoreface profile measurements were carried out

from the shoreline across the outer boundary of the shoreface and a sediment echo sounder was used for shallow seismic profiling Numerous aerial photographs and topographic maps were considered for the study of the Laptev Sea coastal dynamics by remote methods

The results can be summarized as follows

- The eastern sector of the Lena delta (first terrace) forms the Holocene active part (0 to 6000 a BP)
- The western Lena delta deposits (second terrace) represent a fluvial stage of late Glacial age (14,500 to 10,900 a BP)
- The geomorphology of the Lena delta is strongly influenced by Neotectonic activities
- The average shoreline and cliff top retreat rate for all Laptev Sea coastal sites which consist of ice-rich sediments is approximately 2-2 5 m • year^{-1}
- The maximum rate of coastal erosion was observed on the Northern Cape of Muostakh Island 650 m during 48 years or 13 5 m • year^{-1}
- The sediment input to the Laptev Sea by rivers and shores is of the same order but probably coastal erosion sediment input is considerably larger than riverine sediment discharge

THE EXPEDITION LENA 2000: OVERVIEW AND FIRST RESULTS

V. Rachold[1], M.N. Grigoriev[2], and the participants of the expedition

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In order to continue and to complete the studies carried out in the Lena delta and the coastal region of the Laptev Sea during the expeditions LENA 98 and 99, a third expedition (LENA 2000) to this region was organized from July 28 to August 27, 2000 During this expedition four individual working groups concentrated on the following subjects

1 The first group was based on the Island Samoylov in the central part of the Lena delta The team concentrated on modern processes of permafrost-affected soils
   - the balance of greenhouse gasses (CH_4 and CO_2),
   - microbial process studies regarding the CH_4 cycle,
   - the water and energy balance of permafrost soils
2 The field work of the second team was subdivided into two parts
   - During the first stage sensors that had been installed in the main channels of the Lena delta and in the Tiksi Bay during the expeditions LENA 98 and 99 and since that time had recorded water level and temperatures should be retrieved
   - During the second stage the investigations focussed on coastal erosion and sediment accumulation along the coastline of the Lena delta and the western Laptev Sea sector The work program combined detailed geodetic measurements by a laser-theodolite, recording of bathymetric profiles, sampling of coastal sections, and coastal marine sediments as well as measurements of water temperature
3 The third group focused on multi-disciplinary investigations of ice-rich permafrost deposits and their potential as climate archives The investigations concentrated on Ice Complex deposits along the Olenyokskaya Channel in the western part of the Lena delta The comparison with Ice Complex deposits of the eastern Lena delta (Bykovsky Peninsula) will help to understand the origin and the evolution of the Ice Complex of the entire delta region during Late Pleistocene and Holocene
4 The forth group carried out paleogeographic investigations in the western Lena delta For continuing the geomorphologic mapping of the delta and the age determination of different terraces of the flood-plain, rubber boats were used to visit outcrops along small channels

This talk will give an overview of the fieldwork carried out during the expedition LENA 2000 and will present first results

COUPLING THE DELTA-SHELF SYSTEM OF THE LAPTEV SEA BY GIS: THREE-DIMENSIONAL ANALYSIS AND INTERPRETATION OF ITS REGIONAL ENVIRONMENT

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The scientific goals of the presented Geographic Information System (GIS) are the management of field data focussing on environmental changes and the evaluation of mass transfer and budgets of the Laptev Sea system The studies demonstrate the versatility of this technique to characterize changing physical environments and to handle various spatial and temporal scales The presented approach includes sedimentological, hydrological, morphological, pedological, and biological informations

The base for the seven separate digital elevation models (DEM) of the Lena delta are morphological mapsheets derived from different scales (1 200,000, 1 500,000) If the last 2 DEMs are prepared, the whole area of the delta will be covered AtlasGIS was used for the time-consuming digitizing process The software ArcView and its extensions (ArcInfo compatible data base) revealed the three-dimensional visualisation of the investigated area

Now, the terrain modelling allows realistic scales up to 1 50,000 Besides, an assessment of the DEM-extracted (generalized) informations by comparison with proxy data along field transects is necessary and useful for the model's improvement Difficulties of DEM accuracy result from source maps of different geographical projection systems (metric and decimal degree units) as well as from inhomogeneous geomorphological features, e g , cliffs with their asymmetric and sudden elevation changes

In this study quantitative information about the land-water distribution caused by seasonal water level oscillations of selected regions of the delta region are given The interpolation of slope inclination, hillshade, and classes of coordinate-related sectors reveals environmental features that are important for microclimate, surface temperatures, and different melting of the Lena delta permafrost landscape Also a very different soil and vegetation distribution influences the mobility of sediment particles in terms of a mass transfer budget

The created DEM of the Laptev Sea shelf region is likely to visualize and compare features of the shelf waters (e g , suspension content, currents) with bathymetric conditions The coupling of the marine and terrestrial environments via GIS modelling enables the data management by nearly all working groups to characterize the land-ocean system with its interactions of the Laptev Sea in a real interdisciplinary way

THERMOPHILIC MARINE FAUNA IN THE WESTERN LAPTEV SEA DURING THE KAZANTSEVO TRANSGRESSION

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The Laptev Sea region and its continental hinterland is a key area for understanding the problems related to the Quaternary history of the central Russian Arctic Since recently its paleoenvironment has been actively studied in the frame of joint international scientific cooperation

Recent and fossil biocoenoses are good indicators of the past and recent ecosystems and general trends of their evolution The succession of biocoenoses and their relative sustainability with space and time is determined by the ability to adapt and the ecological range of organisms allowing them to survive under changing environmental conditions

The end of the Middle – beginning of the Late Pleistocene was the epoch of boreal transgressions that reached their maximum between 130 and 70 ka This corresponds to the Kazatsevo interglacial according to the Siberian regional scale (Mikulino of the Russian Plain, Eemian of Europe, and Riss-Wurm of the Alps) The Kazantsevo transgression was the most pronounced in the Western Laptev Sea due to the submergence of the Kara shelf and the deepening of the Khatanga and Vilkitsky Strait depressions For the first time in the

Neo-Pleistocene the warm atlantic waters penetrated far eastward and reached the coasts of Severnaya Zemlya and Taimyr

The hydrological regime of the sea basins, positive seawater temperature, and nearly normal marine salinity favored the existence of a diverse marine fauna The Kazantsevo beds of the Taimyr-Severnaya Zemlya area contain boreal and boreal-arctic ostracode species typical of the upper sublittoral zone with normal salinity and relatively warm temperatures Foraminiferal assemblages of the Kazantsevo age include not only cold-water species, but boreal-arctic forms Molluscan assemblages contain boreal species now inhabiting the Barents and Norwegian seas that are able to penetrate not farther than the southwestern shallow Kara Sea

The presence of boreal and boreal-arctic forms in the faunistic assemblages of the Kazantsevo age gives evidence for wide connections between the central arctic paleobasin and the Atlantic Ocean and the penetration of the Gulf Stream to the central arctic region

Thus, the Kazantsevo transgression was the largest boreal transgression during the Late Pleistocene epoch

CONTROLS OF METHANE FLUX FROM POLYGONAL TUNDRA CRYOSOLS

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Polygonal tundra landscapes are widely distributed in vast areas of the near-shore North Siberian lowlands connected with the shallow shelf of the arctic seas like Kara and Laptev seas These ecosystems are significant sources of atmospheric methane and are very sensitive to possible climate change The objectives of multiyear Russian-German cooperation studies of methane biogeochemistry and CH_4 emission in polygonal tundra sites of several Siberian wetlands were 1) to receive data for the estimation of Siberian tundra CH_4 emission 2) to evaluate the effect on CH_4 flux of main environmental factors such as temperature, water table depth (WTD), soil thaw depth (STD), and type of vegetation, 3) to elucidate the interaction of CH_4 generation, oxidation and emission, and 4) to develop a basis for biogeochemical models of tundra CH_4 flux

The CH_4 fluxes from polygonal tundra soils of the Lena River delta in an active period of 1999 varied from 5-10 to 75-80 mg CH_4 m^{-2} day^{-1} The data show that Siberian polygonal tundra CH_4 flux ranged within reported soil CH_4 fluxes in the other arctic tundra regions The increase of soil temperature and STD controlled the rise of methane flux in the beginning of summer when soils are water-saturated to the surface by the activation of methane generation The variations in the late summer CH_4 flux in polygon depressions may be attributed to changes in WTD caused by the alternating summer droughts and rainfalls The difference in WTD was also critical in determining the magnitude of the difference in CH_4 flux in the center of polygon depressions (25-80 mg CH_4 m^{-2}, day^{-1}) and in elevated polygon borders (5-10 mg CH_4 m^{-2}, day^{-1}) in Lena delta sites WTD controls CH_4 emission by the regulation of the thickness of aerobic CH_4-oxidizing and anaerobic CH_4-generating soil layers and position of the roots of vascular plants within or out of the methane-rich soil layer CH_4 transport mediated by the vascular plants was the main mechanism of CH_4 flux Soils covered by mosses demonstrated substantially lower CH_4 fluxes even when WTD was on the soil surface and soil CH_4 store was high Active methane oxidation was detected in decomposed *Sphagnum* moss on the water table level

The balance of CH_4 in the soil and its control by the biogeochemical processes can be expressed by the equation $MF = MG - MO \pm \delta MS$, where MF is CH_4 flux, MG is CH_4 generation rate, MO is CH_4 oxidation rate, and δMS is the change in CH_4 store in soil MG and MO rates were determined throughout an active soil layer up to the permafrost border at low positive and near zero temperatures using "in situ" incubations of fresh soil

samples and ^{14}C-labelled substrates MS was calculated from CH_4 concentrations in soil pore waters

It is essential to continue monitoring of MF, MG, MO, MS parameters and environmental variables in the North Siberian tundra from the beginning of soil melt-up to its complete freezing in late autumn in order 1) to estimate CH_4 balance, 2) to model CH_4 flux, 3) to forecast changes in CH_4 emission induced by the predicted Climate Warming

DRILLING BY ELECTROMECHANICAL METHOD ON THE AKADEMIYA NAUK GLACIER, SEVERNAYA ZEMLYA ARCHIPELAGO

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In May 1999, the drilling of a borehole through the entire ice strata (around 750 m) was initiated on the Akademiya Nauk glacier of Komsomolets Island, Severnaya Zemlya Archipelago The Arctic and Antarctic Research Institute (AARI), St Petersburg Mining Institute (SPMI), and Alfred Wegener Institute (AWI, Germany) take part in this venture

For undertaking drilling activities, a dismantling drilling complex was designed and manufactured at SPMI by request of AWI It includes a drilling house, land drilling equipment, and two sets of the electromechanical drill KEMS-127 that also allows the drilling of subglacial mountain rocks The core has a maximum length of 1 5 m and a diameter of 106 mm

Drilling started in spring 1999 and 54 m were drilled In April 2000, the borehole drilling was continued By the end of seasonal work (May 9, 2000), the borehole bottom reached a depth of 504 7 m

After the drilling was stopped, a complex of geophysical observations was carried out that included measurements of the borehole diameter, the axis deviation angle from the vertical, temperature at different depths and drilling fluid pressure

An analysis of the data obtained allows a conclusion about the reliability and stability of the drilling technology and equipment and developing recommendations to continue drilling that is planned to be done during the 2001 season

FIRST RESULTS OF POLLEN MONITORING IN THE LENA DELTA (ACCORDING TO THE CONTENT OF POLLEN TRAPS)

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During the Russian-German „LENA-98" and „LENA-99" expeditions, three spore-pollen traps were set up in order to determine the composition of recent spore-pollen spectra for different areas of the Lena River delta and reveal the features of pollen air transport along the meridional delta profile The traps were set up in the southern delta area on Samoylov Island (L-3 with the coordinates 72°22'43" N, 126°31'08" E , in the central delta area on Jeppiries-Sise Island (settlement Yugus Jie) (L-2 with the coordinates 72°50'17" N, 125°49'15" E), and in the northern delta area on Sagastyr Island, southern coast of the Laptev Sea (L-1 with the coordinates 73°23'14" N, 126°36'53"E)

The traps were set up and their content analyzed in accordance with the methodological instructions of the European Pollen Monitoring Programme (S Hicks, B Ammann, M Latalowa et al , 1996)

Based on the meteorological observation data of the Tiksi Administration for Hydrometeorology and Environmental Control (a courtesy of A Gukov) and automatic weather station data on Samoylov Island (a courtesy of J Boike), the wind rose-diagrams for Samoylov, Dunay, and Stolb Islands for the period June 1998 - August 1999 were plotted to reveal the character of the wind regime and clear up its role in pollen air transport

The spore-pollen spectra of all traps are characterized by the presence of pollen of tree, herbaceous, and spore plants

A typical feature of the spectra is the presence in all traps of long-distance transported pollen of *Picea, Pinus, Betula sect Albae, Betula sect Fruticosae* in different percentages The largest pollen quantity of tree plants and shrubs was observed in trap L-3 (southern delta area) comprising more than 58% of the total pollen quantity and in trap L-2 (northern area) comprising more than 28% The decrease of the pollen content of tree plants from south to north in the delta is attributed to the wind regime character The prevailing southerly and southeasterly winds determine the major pollen transport of tree plants from the areas of their growing south of the delta

Along with the long-distance pollen transport of tree plants, all traps have long-distance transported pollen of *Betula sect Nanae* growing over the entire delta and *Alnaster*, whose northern areal boundary passes across Samoylov Island There is a clear tendency towards the decrease of the *Alnaster* pollen in the spectra from south to north with increasing distance from the areal boundaries, which is also governed by the wind regime character in the region

A minimum content of pollen of tree plants of about 8% was recorded in trap L-1 The spore-pollen spectra of this trap are distinguished by abundance and diversity of the pollen of herbs *Poaceae,Cyperaceae, Rosaceae* è *Ranunculaceae* with the dominance of the families, reflecting the character of local vegetation

In general, the pollen composition of herbaceous plants in the spore-pollen spectra of each trap correlates well with that of local vegetation

THE AGE OF THE LOWEST PERMAFROST DEPOSITS ON BOL'SHOY LYAKHOVSKY ISLAND - NEW DATA FROM ^{230}TH/U-AGE DETERMINATION AND PALEOMAGNETIC STUDIES

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Continuous permafrost well preserves freshly deposited organic material like plants or animals Hence, the permafrost deposits of Siberia are unique archives for Quaternary environmental conditions, particularly since there are no other archives like glacier ice, tree rings or laminated lacustrine deposits in this part of the Arctic Absolute age determinations of the organic-rich material as plants and animal fossils bound in permafrost deposits are therefore an essential basis for further environmental reconstruction

^{230}Th/U age determination and paleomagnetic studies were parallelly carried out in 1999 for different units of permafrost deposits at the sea cliff near the mouth of the small river Zimov'e. A first horizon of debris of about 5 m thickness with stones in a silty matrix and peat inclusions is exposed on the cliff above a weathering crust near the shoreline The sediment is quite ice-rich (ice content 60-150 % of the dry-weight) and dissected by big ice wedges (3 m wide), which continue below sea level This horizon contains a 30 m long and approximately 1 m thick peat lens (ice content up to 400 % of the dry-weight) The succeeding second horizon of 5 m (up to +10 m a s l) consists of ice-poor homogeneous silty fine-grained sand with only small contents of organic matter (vertical grass roots) and only small ice wedges (0,2 m width) The second horizon is followed by the 20 m thick sequence of the Late Pleistocene Ice Complex

^{230}Th/U ages were determined by thermal ionization mass spectrometry (TIMS) from the permafrost peat lens within the first yielding of a Pre-Eemian "isochron"-corrected ^{230}Th/U age of 201 ± 3 ka The results are methodically reliable as this permafrost deposit behaves like closed systems with respect to uranium and thorium Therefore, frozen peat deposits showing ages beyond the range of the radiocarbon method might be good archives for age determinations using the ^{230}Th/U-method

Paleomagnetic investigations were carried out in the same section above the peat lens Further studies in the Laboratory of Main Geomagnetic Field and Magnetic Petrology of the Institute of Physics of the Earth of the Russian Academy of Science show that the magnetization of the samples has a sedimentary genesis Three samples have a normal magnetization whereas five samples have a reversed magnetization The rest of three samples shows intervening values, which can be associated with the boundary zone between normal and reversed magnetization in the section In context with the ^{230}Th/U age of the peat lens below, the reversion of the magnetization could be interpreted as the Biwa-I-event (180 ka)

PERMAFROST DEPOSITS IN THE LAPTEV SEA REGION AS QUATERNARY PALEOENVIRONMENTAL ARCHIVES – POTENTIALITIES AND PERSPECTIVES

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Permafrost sequences were investigated in three locations of the Laptev Sea region from 1998 to 2000 In contrast to previous studies of such deposits multidisciplinary investigations have been carried out At all sequences studies, we tried to obtain the highest possible time resolution

The results obtained from the three locations show the variable and complicated character of permafrost deposits in the coastal lowland The profiles on the Bykovsky Peninsula near Tiksi consist of continuous sequences of syngenetic frozen sediments covering a period from about 60 ka BP during the last glacial cycle until the Holocene The section on the South coast of Bol'shoy Lyakhovsky Island contains syngenetically frozen deposits formed during cryochrones (Pre-Eemian - about 200 ka BP, Late Pleistocene) and horizons transformed and accumulated during thermochrones under the influence of thermokarst and thermoerosion Another situation was observed in the western Lena delta, where a strong change of facial conditions took place during Middle Weichselian time from fluvial sandy deposits to silty and peaty deposits accumulated on poorly drained flood planes or/and flat slopes The profiles of the last two sections seem to be influenced by tectonic events

All studied sequences were dated or will be dated with overlapping methods (radiocarbon, IR-OSL, ^{230}Th/U) to cover the whole period of more than 200 ka Detailed geocryological, sedimentological, geochemical, and mineralogical investigations allow to characterize the development of sedimentary and postsedimentary processes under the influence of environmental fluctuations Hydrochemical and stable isotope studies of ground ice indicate clear differences between Pre-Eemian, Middle Weichselian, Late Weichselian, Holocene and recent ice wedges, and allow the reconstruction of climate parameters like temperature and humidity The differences in $\delta^{18}O/\delta D$ ratios were probably caused by changes in atmospheric circulation patterns in the Arctic region Additionally, palynological, carpological, as well as entomological studies permit to obtain information on the paleoenvironment conditions during the Late Quaternary and to understand the complicated structure of the former tundra landscapes The study of additional micro-bioindicators (diatoms, ostracods, rhizopoda) is still in the beginning The Late Pleistocene Ice Complex deposits contain numerous buried paleosols That provides a possibility to investigate the character of paleosol formation by help of pedological methods Especially pedochemical parameters such as content of Corg, N, C/N, $\delta^{13}C$ of organic matter, content of pedogenic oxides permit to obtain information on relatively short-term fluctuations of local surface conditions The most significant change of all proxies occurred at the Late Pleistocene-Holocene transition A further completion of our investigations will allow to obtain a geochronological well-established complex data set, which will permit to reconstruct the Quaternary environmental history of the Laptev Sea region The results from permafrost can

be related to paleoclimate records from ice cores and marine sediments and as basis for the modeling of permafrost development in the Laptev Sea region and adjacent Siberian areas

THE BIOLOGY OF THE LAPTEV SEA

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While we have good knowledge about the western arctic shelf seas, the eurasian shelf areas have only been scarcely investigated Several Russian expeditions to the Laptev Sea have investigated biological issues of taxonomic and zoogeographical nature using diving techniques or dredges from small boats But due to its remoteness and 8 month ice coverage knowledge has been limited on ecology, turnover processes, coupling of marine communities

The main approach of the biological working group of the Laptev Sea project during the last years has been to investigate the sea ice habitat, pelagic and benthic community structures, and the interactions between these habitats Interests therefore have been manyfold Taxonomic and zoogeographical questions have been adressed and (several hundred benthic and zooplankton species could be identified) abundance and biomass composition whereever possible gave valuable insights about community structure and distribution patterns

Community structure analysis revealed three distinct faunal provinces in the western, northwestern, and the Lena delta region Those provinces showed in the phytoplankton communities in the zooplankton as well as in the benthos giving a first clue about a tight benthic-pelagic coupling

In a second step, process-oriented studies have been carried out to investigate biological carbon sources as phytoplankton production, its transformation in the pelagial, and degradation in the benthos High chlorophyll *a* contents in the sediment hint to a rapid sinking of phytoplankton blooms to the benthos making high quality food available for benthic organisms as well

Already early in the year phytoplankton production is possible in the polynya region, which is dividing the fast and sea ice from east to west app 200 km north of the Lena delta Hence this all-the-year-round ice-free water is very important for all biological processes Recent investigations will give valuable insights into sources and sedimentation pathways in this important area

CARBON SOURCES AND SINKS IN THE LAPTEV SEA

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The Laptev Sea proper is a rather shallow shelf area with a water depth of up to 50 m Therefore it is postulated that interactions between the pelagic environment and the sea floor are close Primary production may act as a direct food source for the benthos, which is not altered by zooplankton during sedimentation events

This paper gives an overview of the trophic dynamics of the Laptev Sea ecosystem as far as it is known In a synoptic approach primary production measured as ^{14}C, zooplankton and benthos biomasses, abundances, and respiration could be measured on several stations throughout the Laptev Sea Chlorophyll *a* measured in sediments and the water column gave detailled information about the flux of organic material to the sea floor Near the Lena

River outflow signals of phytoplankton blooms in the water column could be seen in the sediment as well

The remineralization of organic material by benthic organisms is an important factor for the overlying water column Released nutrients are an additional source of nutrients for phytoplankton This is particularly true for shallow shelf seas like the Laptev Sea

The shelf area can be distinguished into three faunistic provinces which are reflected in the phytoplankton, zooplankton, and benthic communities as well giving first clues of a tight benthic pelagic coupling

Based on the results of the previous TRANSDRIFT expeditions, the current knowledge on biotic and abiotic parameters shaping communities and their trophic interactions will be compiled A perspective is presented on future work to fill the gaps in the current knowledge of the marine ecosystem of the Laptev Sea

LATE QUATERNARY SEDIMENTATION HISTORY OF THE LENA DELTA

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Borehole and outcrop data in connection with geophysical surveys from Lena mouth deposits have been used to reveal the Late Quaternary history of the Lena delta Age determinations, physical, geo- and hydrochemical properties of the sediments allow to reconstruct the processes controlling the late Quaternary conditions of accumulation and deposition

The development of the three major fluvial terraces are controlled by complex interactions among several main factors (1) Channel migration According to the distribution of ^{14}C and OSL age determinations of Lena mouth sediments, the major river runoff direction shifted from the west in the Early/Middle Weichselian (third terrace deposits) towards the northwest in the Late Weichselian (second terrace), to the northeast and east during the Holocene (first terrace deposits) (2) Eustasy Sea-level rise from the last Glacial regression until reaching its modern position at 6000-5000 a BP resulted in back-filling and flooding of the palaeovalleys The actual delta setting comprises only the eastern half of the geographical delta plain (3) Neotectonics Dilatation movements of the Horst and Graben pattern of the Laptev shelf with different subsidence rates and differential neotectonics with uplift and transpression on the Siberian mainland seem to have influenced river behaviour (i e , providing accomodation place) Especially deposits of the second terrace in the western half were likely to be preserved against fluvial erosion due to uplift (4) Peat formation Polygenetic formation was most extensive (7-11 m) in the southern part of the delta area between 40000 and 24000 ^{14}C a BP (third terrace deposits) In recent times alluvial peat (5-6 m) is accumulated on top of the deltaic sequences in the east (first terrace) (5) No marine ingressions The hydrochemistry of the permafrost documents that conditions of accumulation and deposition are controlled merely by fluvial processes and any marine influence on modern delta sedimentation can be excluded

EVOLUTION OF LAKE NIKOLAY

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The lake history for Lake Nikolay, western Lena Delta, was reconstructed using shallow seismic and radio-echo sound (RES) profiles and multiproxy sedimentary analyses including sedimentology, geochemistry, magnetic susceptibility, and heavy mineral studies Eleven

shallow seismic profiles (25 km total) of the lake basin, thirteen complementing RES profiles (23 km total) of the lake basin and the surrounding area, and nine sediment cores taken from the lake margin to one of its depo-centers at 14 0 m water depth provide evidence for the lake evolution in post Glacial time Four OSL age determinations and eleven AMS radiocarbon dates of plant remains give a consistent chronology from creating the local sedimentary environment in the Late Weichselian to the forming of Lake Nikolay during the Holocene

Until 12,500 ^{14}C a BP (14500-10900 OSL a BP respectively) a fluvial sedimentation dominated the local environment The outcropping sedimentary deposits are derived from the Lena mouth area and have pure bedload characteristics (horizontal bedding, good sorting in the fine sand fraction) The age successions of the upper part of the sandy sediments indicate a high accumulation rate taking place in a fluvial environment under the upper flow regime The electrical conductivity of the pore water remains low (47 µS/cm), which excludes marine influence on the sediments Radio-echo sounding suggests that the fluvial layering continues at least down to about 80 m For the upper 20 to 40 m the RES records indicate that the sediments are deformed by ice wedge growth of Holocene age as deduced from measurements of the ∂^{18}O-value of the stable isotope fraction in the ice

At 7000 ^{14}C a BP lake sedimentation began after an intermediate time without a sedimentary record Shallow seismic profiles characterize the geometry of basin fills, thickness, and changes of lake sedimentation In addition RES profiles show an internal layering of lake sediments which are object to permafrost conditions Core evidence (max 3 3 m) reveals the lithologic composition the upper 0 9 m consist of organic rich, silty sand (max TC content 3 9 wt%) and can be regarded as the original lake sedimentation The lower 2 4 m consist of pure fine sand that is comparable to the sandy environment surrounding the lake Below a deeper lake basin seismic propagation reaches down to 80 m at maximum into the sediments Here, a seismic record reveals a prominent curved reflector that is assumed to be created by the permafrost table below the thawed talik zone This interpretation is supported by mathematical modelling of the talik expansion The beginning of lake sedimentation coincides with the onset of the regional Holocene climatic optimum, which may have resulted in thermokarst processes promoting lake development in the sandy subsurface The spreading of the shore line has probably merged several small thermokarst lakes together in a paleo fluvial environment forming nowadays Lake Nikolay as the largest lake of the western Lena Delta region

MOSAIC ARCTIC GRASSLAND, SWAMP, OR BARREN TUNDRA: PROBLEMS OF THE ENVIRONMENTAL RECONSTRUCTION OF THE ICE COMPLEX DEPOSITION TIME

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Recent investigations of Ice Complex (IC) at the northern reaches of its distribution – the Laptev Sea surroundings - by the Japanese, German-Russian, and other expeditions refuelled the debate on the character of the past environment and sedimentary conditions of that peculiar syncryogenic formation The suggested environmental reconstructions vary within a wide range – from taiga to barren tundra, and from swamp to dry grassland By cutting off the taiga option (since we assume that it is based on misinterpretation of redeposited and far-transported Pinaceae pollen), we arrive at a much more common reconstruction of mainly treeless, grass and herb-dominated landscape The main question is whether this landscape was mesic (predominantly wet) or xeric (mainly dry with only periodical input of moisture) Such features as very high ice content in the IC sediment, extremely thick ice wedges and some particular cryogenic structures, chemically reducing environment, abundance of green algae and ostracodes are often cited as the evidence of mostly poorly drained landscape, similar to the present wet polygonal tundra On the contrary, the abundance of xerophylic insects and plants suggests a rather high aridity of the environment

We believe that these controversies are not unsolvable The easiest way to overcome them is to assume the past existence of highly differentiated mosaic of biotops, which was supposed by many paleoecologists Thus, our common task is to understand the pattern and the possible range of that mosaic The following considerations seem important for that

1) The simplest model would be the macroscale mosaic – wet tundra in the sedimentary area (valley bottom, floodplain) and xeric tundra or steppe on the „placor" (upland plain) This model works only if the syncryogenic sedimentation of the IC was localized in the valleys Many scientists believe, however, that it was not, but the IC sedimentation was areal or mantle – either fluvial on the unbordered floodplain of furcating channels or polygenetic (eolian, slope, nival, etc) on various topography The problem here is an insufficient understanding of the origin and facial-geomorphological conditions of the IC formation, so the macroscale mosaic model remains purely hypothetical

2) In some IC layers we found steppe insects that require the sum of positive temperatures in the uppermost soil layer not less than 2000° for their life cycle (today in the Lena Delta area – hardly more than 800°) There is also various evidence that the insulating moss cover was much less widespread than now, replaced by more or less continuous grass sod, which in turn facilitated the drying and better aeration of the upper soil layer Wherever those beetles lived, the very fact of their presence suggests some rise in summer air T° and increase in effective insolation during those periods, that certainly affected all elements of mosaic, increasing the depth of the active layer (AL) For permafrost, that summer heat rise was more than compensated by much lower winter T° evidenced by the ground ice isotopic data At such latitude, it is only possible under even higher continentality, that is in agreement with the huge increase of the land area during the regression cycle Our data, however, do not preclude the existence of small and large water bodies

3) Geocryological and sedimentological data from the IC do not prohibit this model As the recent geocryological observations show, neither cryogenic structure nor the growth of thick ice wedges are unconditioned indicators of poorly drained surface Under the syncryogenic sedimentation, only the lowermost part of the AL turns into the sediment and the condition of that bottom AL part can strongly differ from the top of the AL, provided that this layer is deep and with sharp temperature and moisture gradients Some features, such as abundance of algae in the sediment, indicate rather more depositional agent (water) than the constantly wet surface, after floods, algae remains can be extremely abundant on dry flood plain surface in hot arid areas Some other IC features indicate high biochemical activity, implying good aeration and relatively high soil T° The abundance of Cyperaceae pollen in the IC spectra, according to Yurtsev (1981), can be related to various xerophylic sedges, a notable element of the present cold steppe associations (sedge heath)

4) Ice Complex is a peculiar formation, deposited under the climate, essentially different from the modern one and known to support a very different (in fact, extinct) ecosystem It definitely was formed under the „colder-than-today" climate, in the sense of lower mean annual T° But to reconstruct the biotic environment, we should operate with seasonal, not annual, climatic parameters, which could have opposite pattern of changes Attempts to understand the past environment by direct analogies with the present (narrow uniformitarian approach) can be misleading As B Yurtsev wrote (1981), „the most realistic just those reconstructions can be, which assume important differences from the present-day situation " And that we must keep in mind, while trying to decode the past environment

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LAPPAL - THE DATABASE ON THE PLEISTOCENE ENVIRONMENT OF THE EAST SIBERIAN ARCTIC SHELF (LAPTEV LAND PALEOECOLOGY). PRELIMINARY REPORT - I.

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Very few is known about the environment of the Laptev Sea shelf land during the deep regression stages in the Pleistocene, when the general climatic pattern and environment

were dramatically different from modern ones However, terrestrial sediments along the Laptev Sea coast contain rich and various archives of past life They include fossil mammals and insects (a very sensitive indicator of the past environment), plant macrofossils, etc Some of these materials were collected earlier, but not properly dated Interesting materials have recently been obtained in the course of the Laptev Sea System 2000 Program Our project, granted by the Russian-German Otto Schmidt Laboratory (July 2000 – June 2001) is aimed at the recognition of the basic features of the Laptev shelf land environment and climate during the Pleistocene from the paleontological and geochronological evidence available The first step to achieve this aim is to summarize different kinds of paleoecological information under the dating control and to provide the background for its adequate interpretation through the better knowledge of modern ecology and distribution of organisms The main task of the project is to create a group of three linked databases (insect, mammal, and geochronological) These databases will serve as a necessary framework for the current analysis of the shelf land environment, its properties and dynamics, and for the interpretation of paleoecological evidence to be obtained in future from the Laptev Sea area, both from the coastal sites and from the drilling cores in the sea

During the first stage of our work, we have developed the general database structure (demonstrated on the poster) and prepared the first set of the data on the Laptev Sea area fossil insect and mammal assemblages for the input into the database We have also compiled the data set on radiocarbon dates obtained from mammal bone collagene in the whole Laptev Sea surroundings

The ^{14}C data clearly indicate the permanent presence of large grazing mammals (mammoth, horse, bison) all over the area around the present Laptev Sea during the last 50-12 Ka, but also imply possible lowering of their numbers between 15 and 20 Ka

ATMOSPHERIC INPUT OF NATURAL AND ANTHROPOGENIC TRACERS INTO THE LAPTEV SEA AND ADJACENT ARCTIC OCEAN

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Within the framework of the Otto Schmidt Laboratory Fellowship Program, the authors plan in close cooperation with German colleagues (Dr R Stein and Dr M Kriews, AWI-Bremerhaven) to study the atmospheric input of natural and anthropogenic tracers in the Laptev Sea and adjacent Arctic Ocean and to compare it with other pathways of these tracers (river discharge, sea ice, etc) Our data and samples of aerosols, snow, water from melt ponds, ice-rafter sediments from the Laptev Sea and adjacent Arctic Ocean, as well as soils, moss, and lichens from the Laptev Sea hinterland could be used All material was collected during the SPASIBA-91 expedition (August-September 1991) and during the ARK-XI/1 (July-September 1995) and ARK-XIV/1a (July 1998) expeditions of RV "Polarstern", respectively Furthermore, relevant material provided by Russian colleagues and literature data will be performed in laboratories in Moscow, St Petersburg, and Bremerhaven, including optical and scanning electron microscopy, X-ray diffractometry, instrumental neutron activation analysis, inductively coupled plasma mass spectrometry (ICP-MS), calculation of back trajectories of air masses It will be a contribution to the research program "Laptev Sea System 2000" In July-September 2000 the authors collected available data on the subject of our research in libraries and the internet Samples of particulate matter from the snow cover and ice-rafted sediments of the northern part of the Laptev Sea and adjacent Arctic Ocean have been prepared for scanning electron microscopy and mineralogical analysis Back trajectories of air mass transport in areas of aerosol sampling in ARK-XI/1 expedition of RV "Polarstern" (July-September 1995) have been constructed together with A A Vinogradova and T Ya Ponomareva A A Klyuvitkin and A N Novigatsky studied aerosols and particulate matter in the snow in the Laptev and East-Siberian seas during the expedition onboard RV "Akademik Fedorov"

FACIAL CONDITIONS OF ICE COMPLEX FORMATION ON THE BYKOVSKY PENINSULA – RESULTS FROM SEDIMENTOLOGICAL, MINERALOGICAL, AND GEOCHEMICAL STUDIES

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Until now the genesis of Ice Complex deposits remains unsolved Complicated processes participating in Ice Complex formation can be deciphered only by use of a number of different methods reflecting varied characteristics In this poster results from sedimentological, mineralogical, and geochemical studies of deposits from the Ice Complex key section „Mamontovy Khayata" (Bykovsky Peninsula) which represent an age sequence of about 60 ka BP are considered The specific features of this section are a very high content of ground ice in the form of banded and reticulated lens-like cryostructures as well as huge polygonal ice wedges and the appearance of numerous soil horizons This is reliable evidence for a syngenetic transfer of sediments into permafrost

According to their grain size characteristics the deposits belong mainly to fine grained silty sands and sandy silts with low sorting The mean diameter of the sediments is in the range of 50 to 250 µm and increases generally with increasing altitude The granulometric curve of the main part of deposits does not show any maximum Only some horizons, especially in the lower and upper part of the section, differ from the dominating sediments by better sorting and have a clear size distribution maximum in the sand fraction

The mineralogical composition of clastic compounds in the grain fractions > 63 µm is characterized by a very high content of rock fragments (chlorite slate, sandstone, siltstone), predominance of feldspars in relation to quartz, and a low heavy mineral content in all investigated deposits Minerals with low stability to weathering such as pyroxene and amphibole predominate constantly in the heavy fraction The content of minerals with extreme stability - (zircon and tourmaline) - and high stability - (rutile, anatase, sphene and other) - is always very small A clear trend in the changes of the mineral composition during the whole accumulation of the sequence was not determined The small differences observed in the mineral composition seem to be caused by variations in rock properties in the source area and in changing hydrodynamic conditions of transport and accumulation

Pedogenic processes have affected the deposits of the Ice Complex as long as they were located in the active layer Different peaty soils were formed, leading to a significant accumulation of organogenic compounds (C, N, S,) and to the mobilisation and redistribution of Fe, Mn, and Al in fine disperse mineral phases Changing climate conditions are clearly reflected in the intensity and character of pedogenic processes allowing a climate stratification of the sequence

Despite the climatic fluctuations during the Late Pleistocene, the source areas - the neighboring Kharaulakh Mountains - as well as the kind of transport of clastic material to the accumulation area remained more or less constant Slope processes and periodical fluvial running, eolian processes as well as soil erosion within the accumulation area have determined the specific features of the Ice Complex deposits

WARM FOGS OVER THE LAPTEV SEA

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An interest in arctic fog studying is linked to the need of the correct account of their influence upon the heat and water vapor flows in the "sea-atmosphere" system For many subpolar areas operative and exact fog forecast is necessary It is also known that water mists sharply accelerate the sedimentary process and chemical conversion of aerosol material

The experimental research at Franz-Josef Land [1] and the Laptev Sea [2] shows that during the transitive periods of spring-summer and summer-autumn the probability of marine fog and haze is rather high So, from July to September 1995 over the Laptev Sea the water droplet fog or dense haze took place more than 50 % of the observable period (all cases when the concentration of aerosol particles D>2 μm exceeded the background value by the factor of 10-100) It must be noted that the current satellite observations did not allow to fix the spatial sizes of the fog area as well as to mark the fact of insufficient visibility

Features of the Laptev Sea fogs - aerosol dispersity D = 0 5 - 15 μm, water content and transparency, as well as fog and dense haze statistics - are presented as functions of direction and wind speed, air and marine temperature

Installed for the August - September period (when the ice cover in the Laptev Sea is minimal [3] three sorts of fogs can be formed radiation fog (high air humidity, moderate wind, temperature inversion), the storm weather fog after a wind speed of more than 15 m/s, the classic steam fog (weak wind, overcooling air influx and other [4]

DETERMINATION OF ^{10}BE PATHWAYS FROM THE SHELF AREA OF THE LAPTEV SEA TO THE CENTRAL ARCTIC OCEAN AS THE PREREQUISITE FOR THE DATING OF SEDIMENT CORE PS2185-3/-6 FROM THE LOMONOSOV RIDGE

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The cosmogenic radionuclide ^{10}Be has proved to be a sensitive stratigraphic tool for sediment cores from the Arctic Ocean with a negligible content of biogenic carbonate, impeding a reliable δ^{18}O stratigraphy ^{10}Be enables a stratigraphy of arctic sediments whereby high concentrations of ^{10}Be are related to interglacial stages and low values to glacial periods

To achieve a better understanding of the ^{10}Be records in high northern latitudes, we investigated the pathways of this natural radiotracer from the shelf area of the Laptev Sea into the sediments of the Arctic Ocean Therefore our research during the projects "Laptev Sea System" and "Laptev Sea System 2000" aimed at quantifying the sources and sinks of ^{10}Be (atmospheric input, concentration in the water column, depositional fluxes) in the Eurasian Arctic

Our results show that during the Holocene, high amounts of continental ^{10}Be are delivered to the shelf areas by rivers and nearly all of the ^{10}Be is deposited directly in this region We further calculated the river input into the Laptev Sea for the last 130 kyr, which is clearly reduced compared to the Holocene Therefore the only ^{10}Be source for sediments from the Eurasian part of the central Arctic Ocean is atmospheric input

Based on this study we were able to establish a reliable stratigraphy for the sediment core PS2185-3/-6 from the Lomonosov Ridge applying a "constant flux model" with a depositional ^{10}Be flux of 0 3 $\cdot 10^{6}$ at cm^{-2} a^{-1} This value represents the recent atmospheric ^{10}Be input into the central Arctic Ocean Its $^{230}Th_{ex}$ profile and ESR ages confirm our age model

DETAILED PALEONTOLOGICAL AND PALEOENVIRONMENTAL STUDIES ON THE EASTERN LAPTEV SEA SHELF

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The proposed research funded by the Otto Schmidt Laboratory 2000 Fellowship Program is aimed at the paleoenvironmental reconstruction of the eastern Laptev Sea shelf area under post-glacial sea level rise The analysis of marine sediment cores controlled by radiocarbon age estimations gave evidence for the depositional history and general paleonvironmental changes on the Laptev Sea shelf during the Holocene (Dehn et al , 1995, Bauch et al , 1999) Climatic changes in the Laptev Sea region were primarily reflected by variations in freshwater runoff and changes of water masses The latter are expressed in sediment sequence as downcore succession of the fossil assemblages of marine organisms and oxygen isotope variations

The current investigation is focused on a detailed analysis of the long gravity core (530 cm) recovered during the TRANSDRIFT V expedition aboard r/v "Polarstern" (August 1998) at the eastern slope of the submarine eastern Lena valley at the depth of 45 m It will include core description and sampling, analysis of fossil molluscs, foraminifers, and ostracodes, AMS ^{14}C dating and oxygen isotopic measurements on benthic forams and, probably, ostracodes Being linked to the oceanographic data (including the yearly record of the oceanographic bottom station "Yana" deployed at the same locality) and distribution of modern assemblages in the surface samples, this research will give unique evidence of the Holocene paleoenvironment of the eastern Laptev Sea

Thus, the main objectives of the proposed research are the following

- (1) comparison of modern assemblages of molluscs, foraminifers, and ostracodes in the surface samples, their distribution over the eastern Laptev Sea shelf in relation to physical and chemical water mass properties (e g , salinity, organic matter input),
- (2) fossil assemblage studies of molluscs, foraminifers, and ostracodes in the sediments of the gravity core PS 51/138, their downcore variability, comparison with the modern analogues,
- (3) comparison of the fossil assemblages to the temporal changes as given by the variability in riverine input as well as the water depth changes during Holocene sea-level rise,
- (4) paleoenvironmental reconstruction of the eastern Laptev Sea shelf in the Holocene on the basis of modern analogue comparisons (oxygen-isotope ratios of the benthic calcareous fossils to estimate past changes in salinity, a comparison with the modern oceanographic data, especially, records of oceanographic bottom stations, will provide a sound thought basis for interpreting the fossil record)

THERMOKARST LAKE AND LAKE TALIKS FORMATION ON THE BASE OF AN ICE-COMPLEX: DURATION AND PERMAFROST EFFECT

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One of the most important natural events of the Late Pleistocene has been the formation of an Ice Complex - IC - on the emergent sea shelf and coastal lowlands of the syncryogenic deposit The ground ice content in IC reaches 95% in volume It made IC very sensitive to climate warming The next very important event was thermokarst According to existing data the first thermokarst lakes and depressions aliases formed at 11-10 5 Kyr B P (Kaplina, Lozkin,1975) Presumably the formation of thaw lakes started during the Bølling warming event (12 8 Kyr B P) To confirm the time of the beginning of thaw lake formation and possible duration of thermokarst lake origin, a mathematical model and a computer

realization program of it have been created The model of thaw lake formation takes into consideration

- decreasing of thaw lake size due to shore thermoerosion,
- sinking of lake bottom due to ground ice thawing,
- accumulation on the lake bottom of mineral and organic sediments melting down from the IC and
- decreasing of annual bottom temperature with growing thaw lake depth from 0°C up to 4°C The annual lake bottom temperature changed when the thaw lake on the shelf was submerged by seawater with a negative temperature (-1 to -2°C) or on lowland partly drained Due to lake drainage, the water temperature in the shallow lake dropped to +2°C

As initial condition in the model of the thaw lake origin, temperature profiles have been taken from top to bottom of the permafrost Temperature profiles were different depending on the latitudinal position of lakes and the time of the beginning of thaw lakes formation As a final product graphs showing the dependance of the duration of thaw lake formation versus IC thickness were compiled for different environmental conditions Lake taliks formation started from the moment when the IC thawed completely The mean annual temperature of lake bottom deposits was constant and equal to +2°C in the model This temperature is now typical for the largest and deepest thaw lakes on North Yakutia lowlands Lake taliks below the oldest and the larges thaw lakes on the lowlands started to form from 10-9 0 B P Recently the taliks remain closed The thickness of unfrozen deposits in taliks reaches 150-180 m, the lower boundary of permafrost below lake taliks is elevated in dependence on the amount of geothermal heat fluxes The existence of open taliks is only possible below the oldest thaw lakes situated above fault zones with a geothermal heat flux of 90-100 mW/m^2 and more

Thermokarst lakes and depression on lowlands occupied very vast areas On neotectonic elevation and near mountains, alases and lakes occupied approximately 50%, on negative neotectonic structures their surface reaches 90% of the total area Only 10% are occupied by "yedoma" and the bottom of small river valleys Areas transformed by thermokarst lakes testify, first of all, the very vast distribution of ice-rich syncryogenic deposits in the Late Pleistocene Secondly, thaw lake origination leads to an increase of the annual surface temperature to positive values This positive temperature may be preserved for thousands of years It leads more to a decrease of permafrost thickness below lakes and alases than the influence of Holocene climate warming on areas not subject to thermokarst

EARLY SPRING PHYTOPLANKTON DISTRIBUTION AND ACTIVITY IN ICE-COVERED WATERS NEAR THE LAPTEV SEA POLYNYA

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In the Laptev Sea, every winter a polynya (LSP) opens separating an extended area of fast ice from pack ice The fast ice is pushed by southerly winds towards the transpolar ice-drift system of the Arctic Ocean

In April and May 1999 phytoplankton investigations were carried out taking samples through ice holes from the fast ice and pack ice close to the polynya during the joint Russian-German expedition TRANSDRIFT VI Different parameters for phytoplankton abundance and biomass were determined The ^{14}C incubation technique was used to measure the primary productivity of under-ice water samples

During the three weeks of the expedition a clear increase in phytoplankton abundance and biomass as well as in primary production occured The growth season of the phytoplankton commenced early below the ice showing phytoplankton biomass (chlorophyll *a*, particulate organic carbon) comparable to those in summer (August) in the same region At two stations phytoplankton blooms could be detected The phytoplankton assemblages were predominated by diatoms and small flagellates

QUATERNARY DEPOSITS OF BENNETT ISLAND (DE LONG ISLANDS, EAST SIBERIAN SEA)

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The Quaternary deposits of Bennett Island investigated by specialists of the Arctic and Antarctic Research Institute during the 1987 field season are mostly represented by eluvial and diluvial sediments, and less frequently by marine, glacial, lacustrine, and other sediments Marine deposits are associated with 10-20 m, 40-50 m, 80-100 m terraces

Continental deposits represented by sand and sandy loam with gravel, pebbles, and small lenses of peat and detritus were found both in river valleys and on the sea shore Radiocarbon dating of organic matter shows these deposits were accumulated from more than ca 40 kyr BP to ca 29 kyr BP Their pollen spectra are dominated by grains of herbaceous plants that indicate an existence of the generally dry climatic conditions and tundra-steppe landscapes

Glacial deposits are thin (less than 1 m) and represented by the ice-cored end moraine in the northern part of the island and by till deposits confined to the few restricted areas in some valleys The age of the latter sediments has not been determined, but taking into consideration the radiocarbon dates obtained on mammoth tusks (12590 60 years BP, LU-2096) as well as on peat from lacustrine deposits (7380 50 years BP, LU-2028), one may suppose that they could have been formed either between ca 29 and 13 kyr BP or between ca 13 and 8 kyr BP

LONG-TERM SEASONAL VARIATIONS IN ATMOSPHERIC POLLUTION NEAR THE LAPTEV SEA

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The 5-day forward and backward trajectories of air mass transport for the observation point at the archipelago Severnaya Zemlya (79 5°N, 95 4°E) for each day of January, April, July, and October over a 10-year period from 1986 to 1995 have been analyzed The main features and seasonal variations in air exchange processes between this point in the Arctic and the mid-latitudinal regions were investigated Taking into account the seasonal variations in surface temperature inversions, and also in aerosol scavenging mechanisms and velocities, the contributions of the large highly industrialized source-regions to air pollution in the central part of the Russian Arctic were estimated for different seasons In winter and spring, air masses and pollutants mix in the arctic atmosphere as in a large reservoir, and the arctic air may contribute up to 50% to atmospheric pollution at an observation point It was shown that pollution source-region contributions vary not only proportionally to their emissions, but also depend on the contaminant, the season, and the efficiency of atmospheric pollution transport to an observation point Reasonable correlation between the calculated mean concentrations and experimentally determined values for 6 anthropogenic chemical elements (As, Ni, Pb, V, Zn, Cd) has been obtained for the different seasons

The atmospheric pollution transport from the Arctic was studied as yet another way of cleaning the arctic atmosphere in addition to the traditionally considered wet and dry deposition onto the surface The average apportionment of conservative contaminant within 5 days after passing the observation point was estimated for the different seasons The air masses passing through the observation point in winter and spring may take about 30% of pollutants out of the Arctic In summer, however, more than 90% of pollutants transported into the central part of the Russian Arctic deposit then onto the surface inside the arctic region

Monthly and annual average fluxes of 6 anthropogenic chemical elements onto the surface of the Laptev Sea have been estimated, and those calculated values obtained are in reasonable agreement with the literature data available The estimates of annual average depositions on the whole surface of the Arctic Ocean show that these values are less than 1-

2% (depending on the contaminant) of the sum of emissions of all the industrial sources situated in Europe and in the Asian part of Russia

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MICROBIAL METHANE IN THE SYSTEM SEDIMENT - WATER COLUMN - ICE SHEET OF THE LAPTEV SEA

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Methane from marine sources is usually referred to as the least of all contributors to the global methane budget On the other hand, there are large estimations of methane in gas reservoirs and as gas hydrates in marine sediments Especially the big on-shore and off-shore permafrost areas of the arctic coast in Siberia are expected to be important and underestimated sources for atmospheric methane During the first TRANSDRIFT expedition in 1993 relatively high methane concentrations were determined in the water column of the eastern Laptev Sea This was the first evidence of potentially dynamic methane sources of this high latitude shelf region The aim of this study was to investigate the marine methane cycle on the Laptev Sea shelf as well as the microbial and geochemical processes which control methane fluxes in marine sediments, the water column, and the sea ice

Within the scope of the expedition TRANSDRIFT V in August 1998, microbial methane production was determined in two sediment cores from the eastern and western part of the Laptev Sea shelf Down to a depth of 3 meters the sediment did not show any in situ methanogenesis because of the dominant sulphate-reduction due to high sulphate concentrations (average 1400 mg l^{-1}) Below this zone the methane production increased drastically with maximum rates between 3 and 4 nmol h^{-1} g^{-1} A first geochemical analysis showed that the methane generation was controlled by sulphate concentration, the amount of organic matter and the pH value of the sediment Furthermore, a total number of thirty vertical methane concentration profiles of the Laptev Sea water was analysed Some of these profiles did not show any clear methane maximum, which was interpreted as the methane background concentration of the Laptev Sea The highest concentration was detected in a region near the Khatanga Valley The methane concentration showed a constant increase of CH_4 from the top to the bottom of the water column In contrast the methane concentration profile of the western part of the Laptev Sea showed two maxima of CH_4 The first one was detected in a layer close to the pycnocline (20 m water depth) with a methane concentration of 20 nmol l^{-1}, whereas the bottom concentration reached the highest CH_4 values about 70 nmol l^{-1} in 250 m water depth

In April 1999 (TRANSDRIFT VI) a number of ice cores were taken from different places of the Laptev Sea ice cover The length of the cores was between 50 and 160 cm, which were separated in 10 cm subcores for the analysis of methane The methane concentrations of the samples were relatively high with amounts between 10 to 60 mg CH_4 l^{-1} ice This methane will be enclosed into the ice during freezing processes of the sea water In contrast to these results two samples showed methane concentrations of 1500 and 6300 mg CH_4 l^{-1} ice, which was interpreted as in situ methane production within the ice by methanogenic bacteria

The results show that a significant amount of methane exists in the marine system of the Laptev Sea shelf Especially the methane concentration of sea ice seems to be relevant for the global methane budget because this methane will be released directly into the atmosphere in the course of ice melting without beeing reduced by oxidation processes

DYNAMICS OF PARTICLE TRANSPORT ON THE LAPTEV SEA SHELF – FIRST RESULTS OF 36 HOURS MONITORING STUDIES (TRANSDRIFT VIII)

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During the TRANDRIFT V expedition in 1998 two long-term mooring stations have been installed in the eastern Laptev Sea to gather broadband ADCP (Acoustic Doppler Current Profiler) and CTD (Conductivity Temperature Density Meter) data for a period of one year Evaluating the backscatter data of the ADCP showed a dynamic system of various backscatter signals within the water column near the sea bottom a layer of high backscatter probably representing the nepheloid layer and in various depths layers of moderate backscatter of unknown origin could be recognised Both layers appeared in different time periods Therefore a multi-method approach was employed during the TRANSDRIFT VIII expedition for the verification of these backscatter data

For a period of 36 hours each hour measurements with a nephelometer, a turbidity meter measuring particles by optical backscatter, connected to a CTD have been done Each four hours water samples of about two liters each have been taken in different water depths depending on the backscatter signals of the nephelometer These water samples have been filtered through pre-weighed HVLP filters by MILLIPORE (0 45 microns) used for the determination of the total suspended matter concentration Three times an on-line underwater camera system for the visual determination of organic aggregates and nepheloid layers within the water column was used For the whole period of time a broadband ADCP was deployed

Preliminary results of the evaluation of the gained data show one nepheloid layer in shallow parts of the Western Laptev Sea In the deeper channels two nepheloid layers could be determined Therefore a lateral advection of particles in the eastern Laptev Sea may be assumed Particles are probably transported from higher sandbanks into deeper channels Within the water column a gradual downwards movement of the upper nepheloid layer could be recognised

CHEMICAL CHARACTERISTICS OF PERMAFROST SOILS OF THE LENA DELTA AND NEW SIBERIAN ISLANDS

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The soils of the Lena delta and New Siberian Islands were studied by us during 7 field seasons, from 1993 to 2000 Now we have got results of the chemical analysis of these soil samples and we have the possibility to compare their chemical characteristics Areas of works are Kotelny, Big Lyakhovsky, Zhokhov, New Siberian Islands (New Siberian Archipelago), Samoylovsky, Tit-Ary Islands (Lena delta), and the northern part of the Charaulah Range

The positions of analysis are determination of pH, P_2O_5, K_2O, content of humus, salts, and granulometric composition

The chemical characteristics depend on both research region and soil type in a certain area The general tendency of their change is traced

TOP SOIL OF ZHOKHOV ISLAND (NEW SIBERIAN ARCHIPELAGO)

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A research of top soil of Zhokhov and New Siberia islands (New Siberian Archipelago) is carried out Samples for chemical analysis were collected (103 from Zhokhov and 104 from New Siberia) The study of Zhokhov soils was realized for the first time

The sufficiently monotonous top soil of the Island is conditioned by the following reasons

1 Small area and high-latitude location result in that the whole territory of the island falls under the influence of the arctic maritime climate Low temperature, high air moisture, frequent fogs, drizzles, often with snow, absence of frost-free period – these are its features Under the existing conditions the soil profile varied only a little
2 Presence of permafrost and very small depth of seasonal melting (about 30 cm)
3 Monotony of mother bed

A short characteristic of Zhokhov Island soils is given below

Primitive rubbly soils occupy top parts and slopes of not tall detached hills Crustaceous and fruticose lichens cover their top parts, the moss cover is not more than 30-40% Vegetation is often completely absent on steep enough slopes „Soils" represent non-gravel wreckage parent volcanogenic material with melkozem and loamy sand filler

Ground zones along numerous island brooks as well as sandy and pebbly beachs and spits of seaboard may be placed among primitive soils Soil-forming processes do practically not affect them Brook flood-lands are not expressed, but flood-water carries silt during the spring melting of snow and, in that way, alluvial process is here, though to a lesser degree Sea beaches and spits fall under the influence of salt water that reaches here during storms and positive setups and as the result of seepage

Higher areas of seaboard, that have vegetational cover but fall under influence of sea, are occupied by marsh soils All of them are salty to various degrees and often are gleyed

Complexes of cryoturbated soils of spots and cracks occupy the most part of the island The forming of the complex occur in the following way Nannorelief of described places most often is the system „crack – polygon" The microclimate in the crack, which is protected from wind, is more auspicious for vegetation Moss cover is most dense and well developed just here This circumstance results in the forming of a peat horizon in the crack The surface of polygons is most often exposed Firstly, the forming of a vegetational cover is hampered in view of adverse microclimate conditions Secondly, the lower ground horizons in the center go up to the surface upon the influence of cryoturbation Surface horizons shift to the edges of polygons As a result the soil profile of polygon center be found almost completely destroyed while the thickness of the peat horizon in cracks may be big enough, even up to 15 cm and the peat-mineral horizon reaches deep down to the very border of seasonal melting Separate fragments of paleosol humus horizons can remain in the profile of cryoturbated soils Gley above the permafrost horizon can be developed too The most distinct paleosol traces are observed in the area of the archeological dig

Gley soils are formed in low places of microrelief Their profile is simple enough living and dead moss is found from 2 to 6 cm The peat or peat-humus horizon is very thin, most often 1-2 cm It may be absent There are gley horizons down to permafrost

It seems to be possible to finish soil middle-scale-mapping of Zhokhov Island during the field season of 2001

WEATHER, ATMOSPHERIC CIRCULATION, AND HEAT EXCHANGE CONDITIONS IN THE LAPTEV SEA DURING THE TRANSDRIFT VII 1999 AND TRANSDRIFT VIII 2000 EXPEDITIONS

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One of the main aims of our investigation was to study the energy exchange in the Laptev sea and to obtain quantity estimations of these fluxes and relationships with ice and weather conditions Investigations of energy-exchange processes were performed on the base of standard and special meteorological and radiation measurements during the expeditions TRANSDRIFT VII (1999) and VIII (2000) The investigation area extends from air temperature and relative humidity, wind speed and direction, water temperature Those parameters were registrated every three hours by the ship's meteorological station (at 13 m above sea level) Atmospheric conditions were observed from the ship's bridge by visual every three hours, too Radiation characteristics (incoming solar radiation and long-wave radiation balance) were obtained using Russian radiation sensors The temporary distribution of the basic meteorological parameters shows a very close correlation between atmospheric pressure, wind direction and air temperature in the surface layer This is connected with the character of the synoptic situation in the Laptev Sea High atmosphere pressure and low surface air temperature are typical for an anticyclonic situation and connected with wind from ice cover to open water, on the other side, low pressure and high air temperature are typical cyclonic conditions The maximum turbulent fluxes were observed in a period of an antycyclonic situation (minimum - during cyclonic conditions)

ROLE OF DIATOMS IN THE VERICAL PARTICLE FLUXES IN THE NORTHERN LAPTEV SEA (SEDIMENT TRAP DATA)

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Microalgae in particulate matter collected by sediment traps in the Laptev Sea were studied From July 28 to September 4, 1995, during the "Polarstern" expedition ARK-XI/1, particle fluxes were measured at 11 stations at 5, 25, and 75 m depth by short-term (8 5-25 hrs) deployments of small cylindrical sediment traps (D= 12 and 15 cm) attached to ice floes The annual particle flux was measured at the LOMO-2 mooring station (81°04 3'N, 138°55 2'E, depth 1703 m) at 150 m and 1550 m from September 15, 1995, till August 16, 1996 During the diatom bloom from the middle of July till the middle of September amorphous aggregates ("marine snow") with diatoms dominated in the particulate matter collected by sediment traps At 150 m, 54 species of microalgae (40 species of diatoms among them) were found, at 1550 m, 52 species of microalgae (38 species of diatoms) were in the samples *Melosira arctica* and *Nitzschia frigida* were mostly abundant at both depths