TERRA NOSTRA

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Fifth Workshop on Russian-German Cooperation: Laptev Sea System

Program and Abstracts

State Research Center - Arctic and Antarctic Research Institute
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IMPRESSUM

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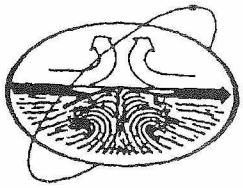

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Program

Schedule

Thursday, 25 Nov., 1999: **ARRIVAL**

17:00	Registration at the AARI
19:00	Icebreaker party at the AARI
21 00	Transfer to the Hotel Chaika

Friday, 26 Nov, 1999

08:30	Transfer from the Hotel Chaika to the AARI
09 00	Welcome and introduction
11.30	Talks: Seasonal and interannual environmental variability
13 10	Lunch
14:10	Talks and Posters: Seasonal and interannual environmental variability
18:30	Transfer to the Hotel Chaika

Saturday, 27 Nov., 1999

08.30	Transfer from the Hotel Chaika to the AARI
09.00	Talks and Posters Terrestrial/marine interactions in coastal zones
13:00	Lunch
14 00	Talks and Posters: Short and long-term environmental changes in the central Siberian Arctic
18.15	Transfer to the Philharmony of St Petersburg
21.00	Transfer to the Hotel Chaika

Sunday, 28 Nov., 1999

08:30	Transfer from the Hotel Chaika to the AARI
09 00	Talks and Posters : Onshore and offshore permafrost: modern processes, interactions, and evolution
13:00	Lunch
14·00	Working groups
18 15	Reception at the Otto Schmidt Laboratory and farewell dinner at the AARI
22.00	Transfer to the Hotel Chaika

Monday, 29 Nov., 1999: **DEPARTURE**

Friday, 26.11.1999

Welcome and introduction

Chairperson: S. Priamikov

09 00 **A. Danilov, J. Thiede, and B. Imerekov.** Welcome

L. Timokhov. Russian-German cooperation in the Laptev Sea

H. Kassens, I. Dmitrenko. One year of scientific research in the Laptev Sea an overview of the expeditions TRANSDRIFT V, VI, and VII

V. Rachold. Highlights of the LENA'98 and LENA'99 expeditions

11.00 Coffee

Oral session: Seasonal and interannual environmental variability

Chairpersons: I.A. Dmitrenko and M. Schmid

11 30 **K.P. Tyshko, S.M. Kovalev, I.A. Dmitrenko, S.V. Pivovarov, H. Kassens, J.A. Hölemann, H. Eicken.** Physical characteristics and crystalline ice structure in the winter/spring period of 1998-99 in the southern part of the Laptev Sea

11:50 **B.V. Ivanov, A.S. Zachek, A.M. Bezgreshnov.** Investigation of radiation and heat interaction processes in the "atmosphere-ice-water" system in the Laptev Sea

12:10 **K.v. Juterzenka.** Ice, water, sediment, and under-ice topography factors influencing sympagic organisms in the Laptev Sea

12:30 **I.A. Dmitrenko, J.A. Hölemann, L.A. Timokhov, H. Kassens.** The oceanographical interactions within the shelf system of the Laptev Sea. The main results of the "Laptev Sea System 2000"

12:50 **S.A. Kolesov, I.Y. Kulakov, L.A. Timokhov.** Modelling of seasonal hydrographical cycles in the Laptev Sea

13 10 Lunch

14·10 **K. Tuschling.** Influence of the Lena runoff on the phytoplankton communities in the Laptev Sea studied during three seasons

14 30 **B.I. Sirenko, S.G. Denisenko, E. Rachor.** Influence of environmental conditions on macrozoobenthos in the Laptev Sea and adjacent waters

14:50 **M.K. Schmid, K. v. Juterzenka, K. Knickmeier, S. Lischka, M. Spindler, K. Tuschling.** Energy flow through the marine ecosystem of the Laptev Sea

15:10 **J.A. Hölemann, I.A. Dmitrenko, L.A. Timokhov.** Broadband ADCP technology - the first results of the interannual measurements in the Laptev Sea

15 30 Coffee

Poster session: Seasonal and interannual environmental variability

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16·00 **L. Timokhov and K. Tuschling.** Introduction to the poster session: Seasonal and interannual environmental variability

The following Poster presentation belonging to this session will be given in the main hall of the AARI. Presenters will be in attendance between 16:15 and 18.00.

E.N. Abramova. Ecology, Seasonal Dynamics and Life Cycles of Copepoda in the Laptev Sea

A. Darovskikh, H. Eicken. Textural features and radar signatures of coastal sea-ice types off the Lena river delta

D. Dethleff. Model scenarios of dense water formation in the Laptev Sea flaw lead

I.A. Dmitrenko, V. Gribanov, S.A. Kirillov, H. Kassens, H. Eicken. Hydrology of the Laptev Sea: seasonal and interannual variability

I.A. Dmitrenko, J.A. Hölemann, V.N. Churun, H. Kassens. The new view on the role of flaw polynyas in the Siberian Arctic shelf environment

P.N. Golovin. Formation of baroclinic currents of convective origin in the flaw polynya of the Laptev Sea

Z.M. Gudkovich, S.M. Pryamikov, B.V. Ivanov, A.S. Zachek, A.M. Bezgreshnov, V.N. Churun. Monitoring of the ice cover contamination and water surface layer in the Arctic Seas

A.Yu. Gukov. New data on macrobenthos in the northern part of the Laptev Sea

A.Yu. Ipatov. Main features of spatial and year-to-year non-tidal variability of Laptev Sea level dispersion

G.A. Korneeva-, V.P. Shevchenko, E.-M. Nothig. Static and dynamic parameters of organic matter transformation in the water column of the Laptev Sea

K.N. Kosobokova, H. Hirche. Regional variations in the zooplankton distribution in the Arctic Ocean effect of bottom topography and circulation pattern

V.K. Pavlov, V.V. Stanovoy. Features of formation and long-term variability of thermohaline structure and ocean circulation over the Siberian continental slope

J. Peters, K. Tuschling, Shipboard Scientific Party of the TRANSDRIFT VII Expedition. Oxygen consumption rates in late summer of selected calanoid copepods from the Laptev Sea

S.V. Pivovarov. Oxygen and nutrients in the water masses of the Laptev Sea

A.V. Popov, I.D. Karelin, B.V. Ivanov. Genesis of waters and ice in flaw polynyas of the Laptev Sea and its role in climate change in the North Polar area

I.N. Pospelov. Landscape subdivision of East Taimyr (Verchnaja Taimyra-Pronczisheva Bay sub-longitude transect)

E.B. Pospelova. The floristic relicts in Byrranga Mountains, Taimyr peninsula

V.I. Pozdnyakov. Distribution and abundance of birds and marine mammals in the Laptev Sea

V.I. Pozdnyakov. Monitoring for waterfowl in the Lena delta

D.V. Solovieva. Bird and mammal fauna over the Laptev Sea polynya in spring

G.I. Yurasov. Variability of oceanographic parameters in the Arctic coastal zone; The Laptev Sea System

A.S. Zachek. Radiative-climatic researches in central Arctic region

E.A. Zakharchuk, A.K. Gusev. Spatial-temporal variability of sea level in the Laptev Sea in summer from ERS-1/2 altimeter data

V.V. Zernova, E.-M. Nothig, V.P. Shevchenko. Annual vertical microalgae fluxes in the northern Laptev Sea (sediment trap data)

M.P. Zhurbenko. Lichens and the glacial history of the central Siberian Arctic

V.P. Zimichev, O.I. Panasenkova. Assessment of hydrological characteristics of sparsely studied central Taimyr watershed basins

Saturday, 27.11.1999

Oral session: Terrestrial/marine interactions in coastal zones

Chairpersons: F. E. Are and V. Rachold

09·00 **S.L. Berezovskaya, S.V. Pivovarov.** Biogenious elements outflow forming in the rivers of the Laptev Sea basin

09 20 **G. Schwamborn, V. Rachold, M. Grigoryev, W. Schneider.** Sedimentations and environmental history of the Lena delta

09.40 **F. Are, E. Reimnitz, S. Solomon, S. Razumov, M. Grigoriev, V. Rachold, H. Hubberten, W. Schneider.** Shoreface profiles of high latitude coasts

10:00 **I.P. Semiletov.** Coastal erosion in the Laptev Sea and Dm. Laptev channel geochemical evidence of a terrestrial signal in the sea

10 20 **M.N. Grigoriev, V. Rachold.** Computer techniques for measurement of coast retreat in the Russian Arctic

10 40 **M. Antonow, T. Pohl, G. Grosse, P.G. Dietrich.** GIS Lena delta· data management focussing on environmental changes

11 00 Coffee

Poster session: Terrestrial/marine interactions in coastal zones

11 30 **M.Grigoryev and M. Antonow.** 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 be in attendance between 11.45 and 13.00

M. Antonow, J. Boike. Aeolian sediment transport in the central Lena delta during the late Arctic winter 1998/99

B. Binder, J.A. Hölemann, H. Kassens, M. Antonow, I. Dmitrenko, Shipboard Scientific Party of the TRANSDRIFT VII Expedition. Suspended sediment dynamics in the Laptev Sea. a comparison of different investigation methods

B. Binder, J.A. Hölemann, M. Antonow, Shipboard Scientific Party of TRANSDRIFT VII Expedition. Suspension dynamics of Laptev Sea shelf waters: quantitative data of 1998 and 1999

I.A. Dmitrenko, V.A. Gribanov, D.L. Volkov, S.L. Berezovskaya, H. Kassens. The Role of hydrometeorological factors in the interannual variations of the fast ice extent in the Laptev Sea

M.N Grigoryev, M. Antonow, M. Bölter, H.-W. Hubberten, V. Kunitsky, L.Yu. Pavlova, E.-M. Pfeiffer, V. Rachold, L. Schirrmeister, C. Siegert. Paleoenvironment and modern processes of the Lena delta region

J.A. Hölemann, M. Schirmacher. River discharge and cycling of trace metals in the Laptev Sea

M.A. Nitishinsky. Balance model of hydrochemical regime of the Laptev Sea

M.A. Nitishinsky, Yu.S. Shcherbakov. Biochemical oxygen demand in the Laptev Sea

E. Pavlova, M. Dorozhkina, V. Rachold. Geomorphological structure of the western sector of the Lena river delta

I.I. Pipko, I.P. Semiletov. On dynamics of carbonate system in the Lena river - Laptev Sea System

V. Rachold, D. Dethleff, M. Tintelnot, M. Antonow. Modern sea-ice transport of riverine sediments from the Laptev Sea to the Fram Straight based on clay mineral studies

V. Rachold, H.-W. Hubberten, M.N. Grigoryev, F.E. Are. An international workshop on Arctic coastal dynamics, Marine Biology Laboratory, Woods Hole, MA, 2-4 November 1999

N.I. Savelieva, I.P. Semiletov. Long-range seasonal and annual variability of the Siberian riverine discharges (Lena and others) and their connection with the Arctic general circulation regime

W. Schneider, V. Rachold, M.N. Grigoryev, D.Yu. Bolshiyanov. Russian-German cooperation SYSTEM LAPTEV SEA 2000: the expedition LENA'99

V.P. Shevchenko, R. Stein, H. Eicken, J. Kolatschek, A.P. Lisitzin, V.V. Smirnov, A.A. Vinogradova. Composition of aerosols in the marine boundary layer in the Laptev Sea in summer

A.A. Vinogradova. Anthropogenic pollutants in the western part of the Laptev Sea: atmospheric concentrations and fluxes onto the surface

A.A. Zaitsev, V.V. Belikov, A.N. Militeev. Proposal for creation of a computer model of circulation of water masses and sediments near the coastal zone of the Laptev Sea

13:00 Lunch

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

Chairpersons: L. Timokhov and J. Thiede

14:00 **D. Fritzsche, L.M. Savatyugin, U. Ruth, F. Wilhelms, H. Miller, H.-W. Hubberten.** A new ice core drilled at Akademy of Sciences ice cap, Severnaya Zemlya - first results

14:20 **L. Schirrmeister, C. Siegert, V. Kunitsky, H. Meyer, S. Derevyagin, T. Kuznetsova, S. Kuzmina, V. Tumskoy, F. Kienast, A. Sher.** Paleoenvironmental and paleoclimatic records from permafrost deposits of the Bykovsky peninsula

14:40 **D.Yu. Bolshiyanov.** Oscillation of climate, sea level and glaciers in the Laptev-Kara region of the Arctic in the Holocene

15·00 **H. Bauch, T. Müller-Lupp, H. Erlenkeuser, H. Kassens, P.M. Grootes, R.F. Spielhagen, J. Thiede.** Land-ocean interactions in the Laptev Sea: sea-level rise and variability in fluvial runoff during the Holocene

15:20 **Ye.I. Polyakova, H.A. Bauch.** Late holocene variations in the conditions of fluvial runoff and sea-ice cover in the Laptev Sea

15·40 **E.E. Musatov.** The late cenozoic evolution of the Laptev Sea shelf

16:00 Coffee

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

16 30 **E.E. Musatov and H.-W. Hubberten.** 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 16.45 and 18:00.

I.A. Akhmadeeva. Permafrost soils of Samoylovsky Island (Lena delta) and of the south coast of Big Lyakhovsky Island

I. Andreevna, H. Kassens, B. Kim, V. Kosheleva, E. Musatov, V. Petrova, R. Stein, B. Vanshtein, D. Yashin. Lithology of the holocene veneer on the Laptev Sea continental margin

D.Yu. Bolshiyanov, M.V. Pavlov. Varvometric analysis of lacustrine bottom sediments as a method for determining the age of paleoclimatic events

D.Yu. Bolshiyanov, G.B. Fedorov. Level variations in the basins of the Kara and Laptev seas in Late Neo-Pleistocene based on studies and dating of marine quaternary sediments in the Taimyr-Severozemelsky area

D.Yu. Bolshiyanov, O.M. Antonov, G.B. Fedorov, M.V. Pavlov. The last large glaciation of the Putorana Plateau

H. Cremer. The diatom flora of the Laptev Sea shelf and continental slope: species composition and modern surface sediment distribution

H. Erlenkeuser. $\delta^{18}O$ in the Laptev Sea, LAPEX 94

P.M. Grootes, H. Erlenkeuser. Carbon-14 as tracer in the Laptev Sea

F. Kienast, L. Schirrmeister, C. Siegert. Primary results of plant macrofossil studies from the key sections "Mamontovy Khayata", Bykovsky peninsula: a contribution for the reconstruction of the Laptev environmental development

Yu.P. Kozhevnikov. Northern climatic trend

M.R. Krbetschek, G. Grosse, M. Antonow, G. Schwamborn, V. Rachold, M.N. Grigoryev. Luminescence dating of sediments from Arga Island/Lena delta

S. Kuzmina, T. Kuznetsova, L. Sulerzhitsky, A. Sher. The Late Pleistocene fauna of the Laptev shelf grassland: insects and mammals

T. Kuznetsova, S. Kuzmina, V. Kunitsky, L. Schirrmeister, A. Sher. The fauna of alas sequences in the ice complex area the case of Mamontovy-Bysagasa northwest exposure, Bykovsky peninsula

H. Meyer, A. Dereviagin, C. Siegert. Paleoclimatic changes in the Late Quaternary - evidence from stable isotopes and hydrochemistry of ground ice of the Bykovsky peninsula, Northern Siberia

T. Müller-Lupp, H.-A. Bauch, H. Erlenkeuser, H. Kassens, J. Thiede. Input of terrestrial organic carbon into the Laptev Sea during the Holocene - evidence from stable carbon isotopes

O.D. Naidina, H.-A. Bauch. Palynological records from the Laptev Sea provide evidence of Holocene climate change

B. Peregovich. Heavy minerals in the Laptev Sea from Holocene to present

V.V. Pitulko. New Siberian Islands: environmental changes and the human occupation

P.V. Rekant. The general features of quaternary development of the Laptev Sea shelf sediments cover, as a result of the geological mapping of shelf and adjacent land area

M.V. Riazanova, P.V. Rekant, E.A. Gusev, A.N. Usov. Geomorphic evidence of recent vertical earth crust movements of the Laptev Sea margin

L. Schirrmeister, V. Kunitsky, C. Siegert, G. Grosse, H. Meyer, I. Syromyatnikov, T. Kuznetsova, S. Kuzmina, S. Dereviagin, V. Tumskoy, I. Akhmadeeva. Permafrost deposits as archives for paleoclimate and paleoenvironment - expedition to Big Lyakhovsky Island, 1999

C. Strobl, V. Schulz, A. Mangini. Modelling the pathways of the radionuclides ^{10}Be, ^{230}Th and ^{231}Pa in high northern latitudes

E.E. Taldenkova, H.A. Bauch and the Scientific Party of the TRANSDRIFT V Expedition. Bivalve assemblage studies on the Laptev Sea shelf and their relation to water mass changes during the Holocene

Sunday, 28.11.1999

Oral session: Onshore and offshore permafrost: modern processes, interactions, and evolution

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Chairpersons: N.N. Romanovskii and E.-M. Pfeiffer

9 00	**V.V. Butsenko, V.A. Poselov, E.E. Musatov, A.A. Chernykch.** Seismic evidence of permafrost conditions on the Laptev Sea shelf
9:20	**N. Kaul, H. Kassens, H. Villinger.** Temperature and heat flow measurements on supposed sub-marine permafrost, Laptev Sea, Northern Siberia
9:40	**A.L. Kholodov, A.V. Gavrilov, N.N. Romanovskii.** Onshore and offshore permafrost evolution
10 00	**D. Wagner, H. Becker, I. Akhmadeeva, L. Kutzbach, V.A. Samarkin, E.-M. Pfeiffer.** Seasonal emission of methane from a polygon tundra - biochemistry and microbial processes
10.20	**V. Samarkin, D. Wagner, A. Vlasenko, E.-M. Pfeiffer.** Methane generation in tundra cryosols at near zero temperatures
10:40	**M. Bölter, W. Kloss, W. Quass, B. Schulz.** CO_2-gas exchange measurements in an Arctic tundra environment (Samoylovski Island, Lena delta)
11:00	Coffee

Poster session: Onshore and offshore permafrost: modern processes, interactions, and evolution

11 30 **V. Samarkin and D. Wagner.** Introduction to the poster session. Onshore and offshore permafrost. modern processes, interactions, and evolution

The following Poster presentation belonging to this session will be given in the main hall of the AARI Presenters will be in attendance between 11:45 and 13:00.

I.A. Akhmadeeva. Permafrost soils of Samoylovsky Island (Lena delta) and of the south coast of Big Lyakhovsky Island

H. Becker, J. Boike, D. Wagner, E.-M. Pfeiffer. Seasonal variation of the methane budget in correlation with the water and energy balance of a polygonal arctic tundra, Lena delta/Siberia

S.-O. Bude, N. Kaul, H. Kassens, H. Villinger, J. Thiede. Introduction of a new mini-heatprobe first winter sea floor temperatures and winter sea floor temperature gradients in the eastern Laptev Sea

A.V. Gavrilov, V.E. Tumskoy, N.N. Romanovskii. Mean annual ground temperature oscillation in the Laptev Sea region during the last 400 kyr: method of paleotemperature curves compilation for mathematical simulation of terrestrial and offshore permafrost

H.-W. Hubberten, N.N. Romanovskii, C. Siegert. The role of thermokarst processes in the land-ocean interaction in the Laptev Sea region

A.L. Kholodov, A.V. Gavrilov, N.N. Romanovskii. Onshore and offshore permafrost evolution during the last 400 kyr (4 climatic and glacial-eustatic cycles). records of preliminary modeling

V.V. Kunitsky, L. Schirrmeister, G. Grosse. Snow patches of Khaptagai Tas (Bol'shoy Lyakhovsky Island) - a case study of periglacial phenomena and a possible explanation of ice complex genesis

A.N. Kurchatova, E.-M. Pfeiffer, H. Becker, A. Vlasenko, L. Kutzbach, B. Schulz. Landscape structure of the Lena delta as an indicator of methane fluxes

L. Kutzbach, D. Wagner, H. Becker, E.-M. Pfeiffer. The effect of vegetation on methane fluxes from wet polygon tundra

O.M. Lisitsyna, I.S. Parmuzin. Onshore and offshore permafrost in the Great Lakes area of the Norilsk region

F. Niessen, A. Gierlichs, E. Weigelt, W. Jokat. High-resolution seismic and sediment echosounding investigations of submarine permafrost on the Laptev Sea shelf

W. Quass, M. Bölter, R. Horn. Cryostatic pressure development in freezing and thawing soils

B. Schulz, M. Bölter, W. Quass. Soil microbial studies in an Arctic tundra environment

G.S. Tipenko, A.L. Kholodov. Mathematical model for investigation of permafrost and gas hydrate bodies interaction

V.E. Tumskoy, A.V. Gavrilov, N.N. Romanovskii, G.S. Tipenko. Thermokarst and its role in sea-land interaction on the Laptev Sea shelf

B. Wächter, J. Boike, U. Nixdorf, G. Schwamborn, B. Forkmann. Application of ground penetrating radar for high resolution mapping of permafrost soils

13 00 Lunch

Working groups

14 00 National and international cooperation

D. Fütterer et al. The nature of continental runoff from the rivers Ob and Yenisei and its behavior in the adjacent Kara Sea - a multidisciplinary approach

H. Ito. Role of the fresh water from Lena in the global water balance

14.30 Plans and perspectives :

A. Sher. Multi- or interdisciplinary? Some thoughts about the current Laptev Sea System project and priorities of future research

Working group The interdisciplinary research project "Laptev Sea System 2000"

Chairpersons: J. Thiede and L. Timokhov

15.15 Coffee

15 45 Working group Otto Schmidt Laboratory for Polar and Marine Sciences

Chairpersons: J. Thiede and L. Timokhov

Working group· The TRANSDRIFT VIII expedition

Chairpersons: S. Drachev, H. Kassens, S. Priamikov, J. Thiede

18:15 Reception at the Otto Schmidt Laboratory for Polar and Marine Sciences

Abstracts

ECOLOGY, SEASONAL DYNAMICS AND LIFE CYCLES OF COPEPODA IN THE LAPTEV SEA

E N. Abramova
Lena Delta State Nature Reserve, Tiksi, Russia

Seasonal processes operating in pelagic biocoenoses of the Laptev Sea are still not clearly understood

The mesoplankton of the Laptev Sea has been studied during several recent years including the investigations carried out within the frame of the joint Russian-German project "Laptev Sea System 2000" More than 500 samples from 180 stations recovered in different parts of the sea since 1993 until 1999 have been analyzed As a result, life cycles of 10 common copepoda species have been described Among these are Acartia longiremis, Drepanopis bungei, Pseudocalanus major, P minutus, Mycrocalanus pygmaeus, Limnocalanus macrurus, Jaschnovia tolli, Oithona similis, Oncea borealis, Senecella calanoides

The horizontal distribution of these species depending upon salinity and temperature regime has been revealed Seasonal and interannual variations in duration and the dates of reproductive period have been established The data on the vertical distribution of these species have been obtained

PERMAFROST SOILS OF SAMOYLOVSKY ISLAND (LENA DELTA) AND OF THE SOUTH COAST OF BIG LYAKHOVSKY ISLAND

I.A. Akhmadeeva
Lena Delta State Nature Reserve, Tiksi, Russia

There is not much information about the permafrost soils of the Lena delta and especially of the New Siberian Islands The studies of soils had been episodical and not related between each other Research into permafrost soils was carried out in 1998 and 1999 on Samoylovsky Island (Lena Delta) and in 1999 on Big Lyakhovsky Island (New Siberian Archipelago) within the framework of the Russian-German expedition An analysis of the permafrost influence on soils of both areas and a comparison of this was made The Russian classification of these soils is taken A detailed soil map of Samoylovsky Island is in preparation Layered peatish-sand deposits of the ancient delta flood plain form the basis of the lithological structure of Samoylovsky Island These cut-off lobes are not flooded with flood water at present, but intensively eroded on the side facing the cliffs The island is as if migrate it is destroyed from one direction, where the current is stronger, and deposited from opposite one The river flat takes up the lesser part of the island There are soils of two big groups on the island intrazonal alluvial and zonal non-alluvial Alluvial soils are spread on the flood plain The features of cryogenesis are absent almost completely The fluvial terrace above the flood plain is subjected to the influence of thermokarst Its surface is broken into polygons There are soils of three types here Permafrost Turfness-Gley and Permafrost Humus-Gley are on the apexes, and Permafrost Peat-Gley occupies the centers of polygons In whole soil cover of the island is rather monotonous and simple Quite another thing is Big Lyakhovsky Island More varied forms of mesorelief in the work area (flood plain of rather small Zimovyo river, alases, hills of ice complex, logs) give themselves a diversity of soils But this diversity increases repeatedly by the influence of the cryogenic microrelief (complexes of baydyarakh and depressions) and nanorelief We can see soils of three or four types in one soil pit only for example, soil of spot, crack, mound, and tussock All soils, even the alluvial, are in one way or another cryoturbated The too short time of our being on the island does not permit to make a soil map of a more or less big area, but we have enough data for the characterizing of the types of permafrost soils

LITHOLOGY OF THE HOLOCENE VENEER ON THE LAPTEV SEA CONTINENTAL MARGIN

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Grain size and mineralogical analyses of bottom and uppermost subbottom sediments sampled by gravity cores, box cores, and grabs were performed and interpreted in the light of scarce seismic acoustic data It was found that the variability in lithology and mineral composition of the sediments on the bottom and immediately below is controlled by the topographic features of the shelf Sands are common in near-coastal shallow marine environments In the central part of the shelf, the relative abundance of sands is associated with the ancient Lena river delta and/or the near-bottom position of pre-Quaternary(?) rocks Fine deposits on the bottom surface occur predominantly in bathymetric lows and are characterized by the prevalence of clay and silt Sandy silt becomes more abundant in the interval lying several meters beneath the bottom and reflecting the Late Weichselian (?) regression

Quartz, alkaline feldspars, acidic plagioclases and weathered micas normally dominate among the light minerals The distribution of heavy minerals allows to recognize western and eastern mineralogical provinces. The first is characterized by high contents of pyroxenes, while the eastern province is dominated by epidote and amphiboles Hydromica is most common among clay minerals Increased contents of kaolinite and montmorillonite are usual for shallow marine deposits near the Severnaya Zemlya archipelago, the Northern Taimyr Peninsula and the Central Laptev High due to the reworking of pre-Quaternary weathered rocks

On the whole, paleoenvironments in the Laptev Sea shelf during Late Pleistocene and Holocene time were predominantly influenced by the modification of pre-existing (pre-Late Pleistocene) tectonic landscapes by sea level changes The marine transgression since the beginning of the Holocene was likely responsible for the accumulation of the thin veneer not exceeding 5-10 m, maximally 25 m in thickness, with higher values usually found in bottom trenches and depressions The mineralogical composition of the Holocene deposits shows two different provinces on the western and eastern Laptev Sea shelf These features apparently reflect the influence of terrigenous discharge from different provenances of the Taimyr Peninsula and Anabar Shield in the west and the Verchoyansk Range in the east Bathymetric map, maps of the disribution of heavy minerals, the map of the lithological types of bottom deposits and the map of the thicknesses of Holocene veneer are compiled

AEOLIAN SEDIMENT TRANSPORT IN THE CENTRAL LENA DELTA DURING THE LATE ARCTIC WINTER 1998/99

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During the short Arctic summer season sediment is mainly transported by the Lena river Wind also affects the particle transport of the delta region, strongly stressing the vegetation or wiping it out As a result of the aeolian activity, many deflation plains were observed mainly in the Arga region (NW-delta) Although large meteorological data sets and climatic models exist, the magnitude of aeolian mass transport from the Siberian hinterland via the Lena delta towards the Laptev Sea is poorly understood After break-up, the sediment-laden river ice supplies a large amount of (former) aeolian particles to the Lena river bed and the Laptev Sea shelf

Environmental studies have been performed on the island Samoylov (N 72°22'/ E 126°30, area ~ 1,200 ha) at the end of the winter season in 1999. This island is one of about 1500 islands of that region and is representative for the southwestern part of the delta. Due to the seasonal changes of river water levels, four terraces were shaped with an elevation maximum of 12 m above sea level Water and wind action formed an (thermo)abrasion coast with nearly vertical cliffs and a very narrow beach at the eastern and southern banks

During May and June, the thickness of snow was measured on the island along 19 transects 40 surface snow samples were melted and filtered (0 45 micron HVLP filters by Millipore) to determine the amount of aeolian particles The deposited aeolian sediment is remarkably high during the onset of the Arctic spring and depicts the meteorological conditions during the field period The particle content of the surface snow samples ranges from a few mg/l of fine-grained material to about 10 g/l of aeolian particles The grain size of the aeolian material even reaches the sand fraction greater than 63 microns

A Campbell Scientific automatic weather station installed on Samoylov during July 1998 continuously recorded meteorological parameters The wind speed during the winter months averaged around 4 m/s Maximum wind speeds with up to 10 m/s occurred between December to January and originated from the southwest

GIS LENA DELTA: DATA MANAGEMENT FOCUSSING ON ENVIRONMENTAL CHANGES

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Geomorphology involves the measurement, monitoring, and analysis of forms and the processes that produced them The changes in surface form have been considered from sequential surveys or from historical sources such as maps

Improvements in data capture, processing, and replicability coupled with increasingly powerful and easy-to-use digital terrain modelling (DTM) methods enable not only the efficient graphical display of information, but also the possibility of a sophisticated quantitative analysis of morphological change in two or three dimensions With such advances, the calculations of area and volume changes between time series become routine Morphological data can be collected at a greater range of scales and models of geomorphological investigation applied

A set of geographic maps (scale 1 200,000) was used to create a digital elevation model (DEM) of selected regions of the Lena delta

AtlasGIS was used for the time-consuming digitizing process The software ArcView and its extensions (ArcInfo compatible data base) revealed the three-dimensional visualization of the investigated area

It is possible to export data to other Windows-based mapping software such as MapViewer or to CAD packages These software packages permit further manipulation and cartographic design, with the results being viewed both in soft and hard copy A further manipulation of the data could be done by several GIS such as ArcInfo and MapInfo These systems have the facility to edit the map coverage, but more importantly can attach further spatial information to the map via a relational database EasyPace enables the combination of GIS values with remote sensing data

By reference to diverse applications, this first approach explains some of the basic principles and constraints of the technique Attention is focussed upon the types of analysis possible and the potential for the geomorphological interpretation of results

The case studies demonstrate clearly the versatility of this technique to characterize changing physical environments and various spatial and temporal scales The approach of the GIS Lena Delta offers a complex data management handling sedimentological, hydrological, morphological, pedological, and biological informations

A future aim is the incorporation of a complex data set into geomorphologic computing by real three-dimensional modelling via GoCAD. Then, a very efficient tool for the creation of cross-sections will be available

SHOREFACE PROFILES OF HIGH LATITUDE COASTS

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Coastal evolution is controlled by the interaction between hydrodynamic forcing (waves, currents, and water levels), and a combination of shoreface and subaerial coastal material properties and morphology While much has been learned about the morphodynamics of sandy shores in mid-latitude temperate zones, there is still considerable uncertainty concerning the prediction of coastal behaviour Along high-latitude coasts, our ability to understand coastal and shoreface dynamics is further compromised by a lack of information about the coastline and in particular, the characteristics of the shoreface In this context, we define the shoreface broadly to include all the parts of the seabed affected by waves, this includes the area from the surf zone to the edge of the storm wave-base

Based primarily on data from high energy temperate latitude shelves, the lower shoreface and inner shelves of retreating coasts are covered with a lag gravel (low sedimentation rate areas) or mud over a lag sand (where sedimentation rates are high) whereas the upper shoreface is mostly sand The shoreface-to-shelf transition is associated with a break in slope from the steeper shoreface to the more gently sloping inner shelf However, along some beach profiles, the change of inclination is indistinguishable For instance, the Laptev and East-Siberian seas are extensive and very shallow Waves rework the floor of these seas everywhere up to several hundred kilometers from the shore Obviously it is unreasonable to consider erosion of the sea floor at such distances from the coast as coastal erosion In this situation, the notion of shoreface becomes meaningless However, in order to calculate the volume of sediment supplied to the modern sediment transport system by coastal erosion, it is still necessary to define the boundary between the erosion of pre-transgressive sediments (derived from downcutting) and the reworking of modern marine materials Since the volume of sediments supplied from subaqueous erosion of the foreshore and inner shoreface often exceeds that from subaerial erosion, a critical question for sediment budget analysis is how to determine the outer boundary of the shoreface along shallow, high latitude coasts

Solving this problem involves the compilation of the existing data on shoreface profile morphology from representative Arctic coasts along with information on profile lithology, oceanographic characteristics, and shallow stratigraphy Much of this information exists in the form of hydrographic charts and previous field studies although it is necessary to conduct additional field work in some locations The use of new technologies (e g multibeam bathymetry) may improve our understanding of detailed morphological characteristics Examples of shoreface profiles from different Arctic seas will be presented and discussed to show the diversity of its geometry dependent on oceanographic and geological settings Also, the relations between shoreface morphology and the intensity of coastal erosion or accretion will be discussed

LAND-OCEAN INTERACTIONS IN THE LAPTEV SEA: SEA-LEVEL RISE AND VARIABILITY IN FLUVIAL RUNOFF DURING THE HOLOCENE

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Constrained by radiocarbon dates (AMS) sediment cores from the Laptev Sea shelf provide new insights into the histories of both circum-arctic sea-level rise and land-to-shelf interaction since the last glaciation Today, and presumably also in the past, this Siberian shelf sea in particular was subjected to large amounts of fresh waters from central Siberian rivers which cross the Laptev Sea shelf while flowing into the Arctic Oceans' halocline This freshwater is mainly directed along submarine channels and with it, sediments are being deposited Based on sediment cores from different water depths of these channnels, paleontological, sedimentological, and geochemical approaches may be used to reconstruct not only the timing of the flooding of the shallow shelf itself, but also to determine the temporal variability of the riverine freshwater discharge

Due to the low global sea-level during the last glacial maximum (LGM), the entire Laptev Sea shelf was exposed It is generally believed that sedimentation on the shelf outside the channels was mainly of terrestrial origin governed by deposition of syngenetic sediments (so-called ice complexes) Whether Siberian rivers did drain the shelf area during the LGM remains unclear, although recent data from the central Arctic Ocean seem to indicate that the Siberian river system may have remained active During the transgressional period (until 10 ka), high accumulation rates of total sediment are recorded at sites from the outer shelf and slope (water depths ≥50 m) These data give clear evidence of the enhanced input of sediments from a terrestrial source and, thus, were also related to an increasing riverine outflow during this time Sediment deposition in the outer-shelf area steeply decreased after 8 5 ka The continuously rising sea-level after this time led to the gradual southward retreat of the coastline and sedimentary depocenters Highest sea-level stand was reached in the Laptev Sea around 6 ka

Given the variability on decadal and on centennial timescales, the dispersal and fate of riverine water discharge and its role on the ice regime as well as on water mass properties are a central issue in the understanding of Holocene climate changes in the Laptev Sea, the Arctic Ocean, and beyond this polar region Based on micropaleontolgical and geochemical studies (e g , diatoms, oxygen isotope analyses), temporal changes in salinity are observed in the shelf sediment records The downcore distributional pattern of the fossil species assemblages however also reflect ecological changes which may be strongly influenced by changes in hydrology, nutrients, and sea-ice conditions Oxygen isotope ratios measured on calcareous fossil groups are less affected by ecological parameters, thus, rendering this method crucial for the interpretation of past variations in river water discharge

SEASONAL VARIATION OF THE METHANE BUDGET IN CORRELATION WITH THE WATER AND ENERGY BALANCE OF A POLYGONAL ARCTIC TUNDRA, LENA DELTA /SIBERIA

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This study reports the preliminary results of field experiments carried out on the Island Samoylov in the Lena delta, Siberia (72° 22, N, 126° 31, E) Daily measurements of the methane emissions and high resolution measurements of the energy and water balance were carried out from May to September 1999 In addition, laboratory experiments for the determination of the methane production and oxidation rates were realized The methane emissions were measured with a closed chamber system in combination with a small circulation pump The gas concentration in the chamber atmosphere was determined with a gas chromatograph equipped with flame ionisation- and heat conductivity detector (GC FID/WLD) Emissions were calculated from the increase of the methane concentration over the chamber closure time Temporally and spatially resolved measurements of liquid soil water content and soil temperature together with time series of freezing depth, rainfall, and net radiation allow the calculation of the water and energy balance components during the field campaign

Liquid water content was measured in soils by using time domain reflectometry, wells allowed the determination of the water table position in the soils The abiotic conditions of the soil strongly impact the gas emission rates of the polygonal tundra By connecting the results of the methane cycle with the energy and water balance, we hope to find a relation which makes it possible to simulate the methane emissions of tundra regions under changed climatic conditions

BIOGENIOUS ELEMENTS OUTFLOW FORMING IN THE RIVERS OF THE LAPTEV SEA BASIN

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River runoff is the major source of the chemical elements entering the Siberian Arctic shelf seas For the right estimation of the river runoff share, it is necessary not only to know the quantitative and qualitative composition of the river waters but also to understand those complicate and various physical and chemical processes that form their chemical composition The study of the biogenious elements outflow forming condition in the river of the Laptev Sea basin and the hydrological regime impact on this process is of great interest in this connection and became the subject of the research

The forming of the river water chemical composition occurs under the special conditions of the physical and geographical features of the territory In a number of regions, the rocks of the basin have such a structure that one could expect a higher silicon concentration However, the prevailing of the permafrost everywhere in this region considerably decreases the mother rock influence Biogenious element concentration in the river water is greatly influenced by atmospheric precipitation containing inorganic nitrogen

Hydrochemical data on inorganic nitrogen forms, silicon, total phosphorus were collected during the period 1984 – 1991 years at 12 stations. Basing on this information and physical and geographical features of the territory, they were divided into 3 regions differing in biogenious elements outflow forming mechanisms The first region includes mountainous territory (basins of the rivers Aldan and Yana's upper and middle flow) The second one includes plain territory (basins of the river Lena's middle flow, river Anabar,

Olenek's upper flow, river Vilyuy basin) Basins of the rivers Anabar and Olenek's lower and middle flow (Northern Siberian lowland), river Yana's lower flow form the third region

For each of these regions, the runoff-forming conditions are studied for different phases of the hydrological cycle (flood, rain flood period, summer and autumn low flow period, winter low period) Such an approach is caused by the fact that the summer thawing and winter freezing processes directly influence the forming of the surface water composition On the one hand, the thickness of the thawing layer and the infiltration characteristics of rocks composing it determine the atmospheric precipitation infiltration and rain flood character, liquid precipitation losses on surface interception, and interception in the active layer On the other hand, this layer causes a redistribution of the moisture in time, as water, contained in it, freezes in autumn and enters the hydrographical system in the summer of the next year, increasing the river runoff variation

The carried-out dividing into regions is valid for the flood and rain flood periods when surface-slope and soil-surface waters prevail in the channel system As a rule, there is no summer-autumn low flow period During the winter low flow period, the chemical composition of the surface water is completely determined by the subsurface waters feeding the rivers The main feed source during the winter period is underfrost water but its composition and influence on the biogenious elements content in river water has been studied insufficiently at present

The data used as basis are not numerous To study the problem of biogenious elements outflow forming in Laptev Sea basin rivers, it is necessary to carry out additional field research

SUSPENSION DYNAMICS OF LAPTEV SEA SHELF WATERS: QUANTITATIVE DATA OF 1998 AND 1999

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The riverine input into the Laptev Sea shelf is a major source of particle supply to this region Especially, the Lena delta plays an important role as a distributor of huge amounts of suspended matter each year These particles enter the shelf region, where the marine environment is quite variable and different The winnowing of sediments and resuspension by current action are common features of the shallow Laptev Sea shelf, whereas the accumulation of particles usually occur in the deeper parts (e g , troughs and depressions)

To study recent sediment and suspension dynamics, the in situ particle content of the shelf waters was determined during three expeditions at late Arctic summer and winter conditions One of the aims is the characterization of the transport paths of suspended particles

The quantitative data of suspended particulate matter (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 various SURFER-created maps and transects

Particles in the uppermost water column reflect biological activity (beneath the ice) The common surface PSM content is about 2 to 4 mg/l Further upper maxima of suspension load coincide with oceanographic changes and depend on the positons of the pycnoclines But the distribution of SPM does not depict the very good density stratification of the waters in any case due to internal turbulence The particle transport is preferably realized near the halocline Additionally, a general current-induced increase of near-bottom particle

amount is evident Thus, contents of significantly more than 5 mg/l are recognized Especially, this is a characteristic feature for shelf trough regions deeper than 30 m

The waters near the slope region are characterized by stable mixing conditions Sometimes, local suspension maxima have been observed at the continental slope and are interpreted to represent the effect of internal sediment-laden layers

SUSPENDED SEDIMENT DYNAMICS IN THE LAPTEV SEA: A COMPARISON OF DIFFERENT INVESTIGATION METHODS

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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 matter 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, composition and the spatial and regional distribution of TSM Recent investigations have demonstrated that this can be most effectively done by a combination of different methods

For the first time, this approach could be conducted on selected stations during the TRANSDRIFT VII expedition The different methods used were

- Filtration of seawater through pre-weighted membrane filters having pores of a diameter of 0 46 µm These filters are used for the determination of the TSM concentration Moreover, the filters are used for the characterization of the type and size of particles by means of scanning electron microscopy (SEM)
- Optical backscatter sensor connected to a CTD
- Echo intensity of a broadband Acoustic Doppler Current Profiler (ADCP)
- On-line underwater camera system for the observation of aggregates and nepheloid layers in the water column

The interpretation of these data will be carried out in co-operation with the biological, oceanographic and meteorological working groups

OSCILLATIONS OF CLIMATE, SEA LEVEL AND GLACIERS IN THE LAPTEV-KARA REGION OF THE ARCTIC IN THE HOLOCENE

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Based on the studies and dating of Quaternary deposits, bottom lacustrine sediments, the relief of the Taimyr peninsula, the Severnaya Zemlya and the New-Siberian Islands archipelagos, paleogeographical reconstructions for the last 10 kyr were performed for the Laptev and Kara seas

The July air temperature variation curves for the last 10 000 years, constructed from the pollen assemblage analysis data, clearly indicate an a-synchronous character of the main Holocene climatic events even in the area of the Laptev and Kara seas The Holocene

climatic optimum at the Severnaya Zemlya and the New-Siberian Islands archipelagos occurred at the time between 9 and 10 kyr BP Maximum warming on Taimyr was recoided between 7 and 8 kyr BP Southward along the meridian 100° in Central Siberia, the heat maximum falls into the Atlantic time of the Holocene However, the temperature variations at that time had less contrast compared to the northern territories The moments of cooling and glaciation development were also a-synchronous. The paleotemperature curve of the last millenium, constructed from varve sediments of Lake Izmenchivoye (Severnaya Zemlya archipelago), indicates a noticeable cooling and the development of glaciation during the Little Ice Age epoch that continued in this area from 1580 to 1700 (the coldest phase)

The level rise of the Kara and Laptev seas in the early Holocene was related to the general marine transgression, but it was not uniform and synchronous in different parts of the study area

The curves of sea level oscillations in the mouth areas of the rivers flowing to the Kara and Laptev seas, plotted from coastline dating and the study of the bottom sediments of the lakes connected with the seas, show the onset of the maximum level phases to a shift in time up to several hundred years being sometimes in the opposite phase The last significant level rise in the Kara and Laptev seas occurred during the period 1500 to 800 yr BP At that time, the sea level rise comprised approximately 10 m in the Severnaya Zemlya area, 5 m in the Khatanga river mouth and 5-6 m in the mouth of Nizhnyaya Taimyra River, which influenced the water level rise in Lake Taimyr

THE LAST LARGE GLACIATION OF THE PUTORANA PLATEAU

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Comprehensive studies of the relief structure and Quaternary deposits were undertaken in 1997 and 1999 in the northwestern Putorana Plateau area in the basins of Lakes Lama, Kapchug, Neralakh, Talikit, and Pyasino

Based on the studies of lake topography, bottom lacustrine sediments, and the complexes of ice deposits in the valleys, it was revealed that

1 — the glaciation of the last ice maximum was characterized by the development of ice caps (of the type of current Severozemelsky caps) and thin dead ice covers within the plateau, and active outlet glaciers in the tectonically predetermined valleys,

2 — the ice caps, whose thickness comprised several hundred meters, were located in a chain in the sub-latitudinal direction from Kharayelakh mountains eastward,

3 — an asymmetry of ice cover glaciation was in the fact that the alimentation conditions at the southern cap slopes were more favorable compared to the northern slopes, as the flows of the main outlet glaciers were southward and southwestward,

4 — the main mass of outlet glaciers did not reach the lake valleys and the tectonic valleys on the Putoran Plateau were ice-free,

5 — only some largest outlet glaciers reached the lakes and dammed the valleys resulting in the formation of backwater bodies,

6 — with distance from moist air masses (from southwest) southeastward to the inner plateau areas, the intensity and thickness of glaciation decreased with thin dead ice fields comprising the main type of glaciers,

7 — due to their geographical location, the outlet glaciers of the Putorana Plateau were the warmest compared to all other glaciers of the Taimyr-Severozemelsky area being therefore the most active in the relief formation,

8 — the retreat of glaciation was accompanied by catastrophic discharges of erosion products by melt ice water Near the northern foot of the Plateau, extensive fluvio-glacial debris cones were formed that are cut now by such rivers as Kheta, Avam, Talmi, etc

9 — the time of the last ice maximum is dated as Sartan time (Late Weichselian) being determined only indirectly from paleobotanical studies of the Holocene bottom sediments of Lake Lama [J Hanne and M Melles, 1999, U Kinel, 1999]

10 — dammed basins in the Putorana Plateau valleys also existed in the Holocene (based on radiocarbon dating of deposits from the dams), which does not exclude the development of glaciers at the end of the Holocene as well

LEVEL VARIATIONS IN THE BASINS OF THE KARA AND LAPTEV SEAS IN LATE NEO-PLEISTOCENE BASED ON STUDIES AND DATING OF MARINE QUATERNARY SEDIMENTS IN THE TAIMYR-SEVEROZEMELSKY AREA

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For many years, the authors (AARI) have been involved in the thematical acquisition of actual data for investigating the stratigraphy and determining the absolute age of marine Neo-Pleistocene deposits of the Taimyr-Severozemelsky area This paper analyzes more than 70 datings of marine deposits using different methods The largest series of datings were obtained by the ESR-method A significant number of U-Th datings published in current literature is also analyzed In addition, there are some radiocarbon dates from typically marine sediments, mainly for Severnaya Zemlya At present, a stratigraphic diagram of quaternary deposits has been developed with the reconstructed history of Neo-Pleistocene events for the Severnaya Zemlya archipelago Based on the data obtained, the authors suggest their interpretation of the marine late Neo-Pleistocene events of the Taimyr-Severozemelskaya area

The traditional diagram for the late Neo-Pleistocene in Russian literature includes the marine transgression of the Kazantsev interglacial (^{a}100-70 kyr BP) and a less significant transgression of the so-called Karginsk interstadial (^{a}50-25 kyr BP) This diagram is however reconsidered today by many investigators

The existence of a marine transgression in the early Late Pleistocene (the so-called Kazantsev time) is beyond doubt now However, the opinions about its character, scales and time period differ significantly In the light of the data obtained, this was a long period (^{a}120-50 kyr BP) of high sea level whose current coastline marks reach 200 m above sea level The sea level could not remain stable for such a long time although it had always been higher than the current level During the period ^{a}90-70 kyr BP, the sea level decreased while glaciation developed at the Severnaya Zemlya archipelago and in the Byrranga Mountains

Many investigators now reject in principle the existence of a sea level rise at the Karginsk time due to the little evidence pointing to a sea level rise during this period being mainly confined to Severnaya Zemlya and northeastern Taimyr However, such facts exist and the problem of their reliability is the problem of the reliability of the current methods of dating Quaternary sediments The ingression sea development during the period ^{a} 45-22 kyr BP with the sea level rise of ^{a}35-40 m relative to current level is suggested

VARVOMETRIC ANALYSIS OF LACUSTRINE BOTTOM SEDIMENTS AS A METHOD FOR DETERMINING THE AGE OF PALEOCLIMATIC EVENTS

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The bottom sediments of deep tectonic lakes of the Arctic present a rich archive of paleogeographical information Due to a significant depth and exclusively seasonal non-uniformity of sediment discharge to the lakes, varved clays consisting of a series of varves (annual layers) accumulate there Large depths (about 100 m and greater) and fall diameter of sediments discharged to the lake (clay and silt) make impossible the formation of other (within a season, daily, etc) than the annual varves as it may occur in the shallow water bodies That is why, counting the number of the pairs of sediment layers in deep lakes is a good method for determining the age of sediments

An analysis of the upper sediment layers of the tectonic Lakes Levinson-Lessing and Shchel (Taimyr peninsula), Lama (Putorana Plateau), and Shchuchye (Polar Urals) was performed in the framework of the "Laptev Sea System" Project The annual layers were counted, a pollen assemblage analysis of bottom sediment cores was performed and the sedimentation rates were calculated The latter were comparable with the results of a calculation based on bottom sediment dating using a lead method [B Hagedorn, S Harwart, M M R van der Loeff, and M Melles, 1999] and a radiocarbon method [T Ebel, M Melles, and F Niessen, 1999]

The following results were obtained from bottom sediment studies

1 The sedimentation rate in all water bodies studied for the last 500-600 years ranged between 0 9 to 1 2 mm/year

2 The cyclic sedimentation of clays and silts for several tens-hundreds of years was interrupted by the catastrophic discharges of sand and rudaceous material to the lakes forming sandy-gravel interlayers separating varved clays These catastrophic events were connected with the episodes of the melting of glaciers and firn in the lake basins and with the increased erosion capability of the water flows to the lakes

3 The sand-gravel interlayers in the sediments of Lake Shchel contain the main mass of pollen, spores, and vegetation remains The varved clays are empty

4 The pollen assemblages and sand interlayers of bottom sediments of Lakes Levinson-Lessing and Shchel allowed the dating of the Little Ice Age in the Byrranga mountains

CO_2-GAS EXCHANGE MEASUREMENTS IN AN ARCTIC TUNDRA ENVIRONMENT (SAMOYLOVSKI ISLAND, LENA DELTA)

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During summer 1998 and spring to autumn 1999, we measured the gas exchange of soil samples from different sites at Samoylovski Island These sites were at different spots of a low center polygon field and a sandy soil wedge They represent different soil habitats with respect to water content and organic matter Main emphasis was put on the reaction of samples to temperature and potential temperature shifts These analyses were performed with an infrared gas analyzer (Walz Co, Effeltrich, Germany) Further, gas samples were taken from different points underneath snow or thin ice covers during early spring as well as from deeper soil horizons by Vacutainers (Becton Dickinson, Germany) These samples were analyzed by gas chromatography with an WLD detector

The results of the Vacutainer samples between May 8, 1999, and May 25, 1999, showed a great variability with respect to sampling sites The concentrations of CO_2 underneath the snow cover showed values between 700 and 1200 ppm Higher values were obtained underneath moss carpets which ranged up to nearly 5000 ppm and indicated some

accumulation Some data beneath moss carpets were found even higher at levels of 8200 ppm The bulk of the data on the measurements on soils refer to only a few accumulation rates, taking into account that soils contain per se elevated levels of CO_2 which can be assumed as 500 - 1000 ppm and higher Soil respiration data exhibited only a few micrograms of CO_2 per gram and hour at temperatures close to the freezing point Based on these data of actual CO_2 concentrations in different soil habitats, we make some assumptions on the possible CO_2 production of microorganisms during the time of snow cover considering their metabolic processes at low temperatures, possible diffusion through the snow layer, and further environmental factors

INTRODUCTION OF A NEW MINI-HEATPROBE: FIRST WINTER SEA FLOOR TEMPERATURES AND WINTER SEA FLOOR TEMPERATURE GRADIENTS IN THE EASTERN LAPTEV SEA

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In order to get a deeper insight into the winter temperature regime of the sea floor in the eastern Laptev Sea shelf area, a new mini-heatprobe has been developped This new light-weight heatprobe with a weight of 18 kg and a total length of 1 2 m can easily be operated from the ice through conventionally hand-drilled 20-cm diameter ice holes The temperatures are measured with a 50-cm long needleformed sensor containing 7 thermistors This allows to obtain the temperatures of the sea floor up to a depth of 50 cm The mini-heatprobe can be operated on-line on a PC Additionally during the *in situ* measurements, the tilt of the instrument is recorded in order to establish a quality control of the recorded data Preliminary calculations indicate that the absolute accuracy is ±0 01°C and the relative accuracy is ±0 003°C

First measurements where carried out during the TRANSDRIFT VI expedition in April and May 1999 At 15 stations, successful temperature measurements could be achieved The measured temperatures range from -1 62°C to -0 90°C The highest temperatures of -0 90°C were recorded on shallow shoals south of Vasilievski Bank at 8 m waterdepth, while the lowest temperatures (-1 62°C to -1 50°C) were recorded near the polynya Preliminary calculations of the sea floor temperature gradients at dedicated stations showed positive gradients of about 60 mK/m in the upper 50 cm of the sea floor sediments Positive gradients were observed throughout Similar temperature gradients were observed during the preceding summer season, thus, it can be deduced that positive gradients are a nonseasonal stable feature in the shallow part of the eastern Laptev Sea

The new heat-probe prooved to be a reliable instrument for shallow water/shallow water gradient measurements under rough environmental conditions Especially short term temperature variation, relevant for seasonal and climatic variability can be tackled

SEISMIC EVIDENCE OF PERMAFROST CONDITIONS ON THE LAPTEV SEA SHELF

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One of the major goals of the Russian-German expedition "TRANSDRIFT V" in 1998 aboard the German RV "Polarstern" at the Laptev Sea shelf was the investigation of permafrost conditions The studies were carried out by means of high resolution multi

channel seismic profiling (frequences 50-150 Hz) The upper part of the sedimentary cover is rather variable Four types of seismic conditions are established

1) Zones where usually stratified sedimentary units are unconformably overlain by sequences with interval velocities of 1 6-1 7 km/s

2) Short and rare seismic opaque zones where the correlation of reflectors disappears (interval velocities - 1 8-1 9 km/s)

3) Acoustically transparent zones characterized by inversions of interval velocities (from 1 6 km/s to 1 2 km/s and less downwards across the section) are established. One of the probable interpretations of these zones could be accumulations of methane The most intensive multiples are fixed directly in these zones possibly reflecting boundaries between rocks and gaseous accumulations

4) The last type of seismographic records is characterized by a transition from smooth bottom to destructured one Inner reflectors are chaotic and short while interval velocities increase up to 2 5 km/s These facts make it possible to interpret such zones as subbottom permafrost lenses

Thus, seismic studies constrain the evidence of the presence of isolated subbottom permafrost lenses on the Laptev Sea shelf Probably this permafrost forms not a regional cover but several large "islands" corresponding to the character of the permafrost in the shallowest parts of the Pechora and Kara sea shelves Possibly such permafrost "islands" are present within the eastern Lena horsts dividing Svyatonossko-Bel'kovsky graben from the Ust'-Lena rift The last one is the main element of the whole Laptev Sea Margin rift system where permafrost could be degradated due to the input of heat flow

THE DIATOM FLORA OF THE LAPTEV SEA SHELF AND CONTINENTAL SLOPE: SPECIES COMPOSITION AND MODERN SURFACE SEDIMENT DISTRIBUTION

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In the framework of the multidisciplinary project "Laptev Sea System", a data set of 89 surface sediment samples and 30 water samples was taken during several TRANSDRIFT expeditions to the Laptev Sea All samples were qualitatively and quantitatively investigated with regard to their diatom species content The purpose of this study was, firstly, to identify different diatom plankton communities and surface sediment assemblages within the Laptev Sea shelf region and, secondly, to show a close relationship between hydrologic conditions of surface waters and the diatom record in the water column and the surface sediment

The water samples were analyzed by using a scanning electron microscope During spring and summer, the plankton communities in East Siberia are strongly influenced by the presence or non-presence of a sea-ice cover and by the enormous riverine freshwater input during the ice-free growing season In September 1994, the Laptev Sea shelf could be subdivided into three plankton regions (1) a northern shelf region dominated by marine neritic species of the two genera *Thalassiosira* and *Chaetoceros*, (2) a mid-shelf region, which was characterized by a co-occurrence of marine, brackish water, and freshwater species, and (3) a coastal Lena delta region where species of the freshwater genera *Aulacoseira* and *Stephanodiscus* dominated the plankton communities Typical ice diatoms were not recorded in the water column This distribution pattern of plankton communities clearly reflects the hydrologic conditions of surface waters, especially the salinity The influence of river water decreases from the coastal to the northern shelf regions just as the plankton composition alternates from a coastal, freshwater species dominated to a northern shelf, marine species dominated community

From all surface sediment samples, permanent slides were prepared which were microscopically examined with regard to the diatom flora The surface sediment diatom flora of the Laptev Sea is very diverse and consists of marine, brackish water, and freshwater taxa According to newest taxonomical concepts, a total of 375 taxa representing 79 genera

were identified But most of the taxa show a very rare or sporadical occurrence Only a handful of these taxa occur in higher abundances and characterize the surface sediment assemblages All these important species are planktonic taxa also being typical for the plankton and ice-algae communities Based on a factor analysis, five diatom surface sediment assemblages can be distinguished (1) the ice diatom assemblage (central shelf region), (2) the *Chaetoceros* assemblage (eastern and southeastern shelf), (3) the *Thalassiosira antarctica* assemblage (continental slope and deep sea regions of the Laptev Sea), (4) the freshwater species assemblage (vicinity of river mouths and deltas), and (5) the *Thalassiosira nordenskioeldii* assemblage (patchy occurrence on the central shelf)

The observed distribution pattern of diatom assemblages can be significantly combined with the distribution of plankton communities and the oceanographic conditions of surface waters The main factors controlling the occurrence of diatoms in the Laptev Sea are the freshwater input during summer, which strongly affects the salinity of surface waters, and the sea-ice extent Furthermore, the composition of the *Thalassiosira antarctica* assemblage of the continental slope and deep sea regions is largely influenced by dissolution processes

TEXTURAL FEATURES AND RADAR SIGNATURES OF COASTAL SEA-ICE TYPES OFF THE LENA RIVER DELTA

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In winter, the southern Laptev Sea is covered by fast ice Despite its uniform visual appearance at the end of winter, Radarsat data in 1996/1997 show a coastal ice zonation associated with Lena river discharge and land-ocean interaction Backscatter signatures of different ice types have been derived from helicopter side looking radar and Radarsat SAR data in conjunction with ground measurements SAR image texture has been analyzed based on derivations of the Grey-Level Co-Occurrence Matrix (GLCM) and the Neighboring Grey-Level Dependence Matrix (NGLDM) It is shown that the main ice types can be identified based on a combination of the backscatter coefficients (grey tone) and textural features

MODEL SCENARIOS OF DENSE WATER FORMATION IN THE LAPTEV SEA FLAW LEAD

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Two different model calculations were used to estimate the potential formation of Arctic Cold Halocline Water, Intermediate Water, and Deep Water in the Laptev Sea flaw lead In both models, salt fluxes were calculated from fall and winter salinities and from annual lead-ice production rates The first model (model A) assumed that rejected salt mixed with the surrounding lead water until the lead water was sufficiently saline to contribute to the mid-layers of either the Cold Halocline, the Intermediate Water, or the Deep Water The second model (model B) allowed the rejected salt to descend directly to the upper layer of the Cold Halocline After salt remixing in the upper layer of the Cold Halocline, the resulting dense water contributed again to the mid-layers of either the Cold Halocline, the Intermediate Water, or the Deep Water In both models, western Laptev lead sections east of Severnaya Zemlya and Taymyr are the strongest contributors of dense water toward deeper layers Strong dense water contributing lead sections are also located north of Kotelnyi Island In model A, however, all central-southern and eastern Laptev lead sections contribute less or not at all to deeper water masses because the rejected salt merely increases the low starting salinities (≈5-20 psu) of the lead water bodies In model B, where direct downward salt rejection was allowed, most of the central-southern and eastern Laptev lead sections revealed

enhanced contributions to deeper layers because no salt mixed into the lead water bodies Control calculations for model B show that higher salinities in the upper layer of the Cold Halocline (where the downward rejected lead salt is remixed) led to significantly enhanced dense water production rates because less salt is required to increase the salinity of the upper layer of the Cold Halocline for contribution to deeper layers and, thus, more salt may be rejected downward As averaged from calculations of both models, the entire Laptev flaw lead annually contributes either as much as 0 141 Sv of Cold Halocline Water, 0 068 Sv of Intermediate Water, or 0 059 Sv of Deep Water Western lead sections, which represent only 25% of the entire Laptev lead area available for dense water production, may contribute on average roughly either 73% of the annual Cold Halocline Water, 66% of the Intermediate Water, or 65% of the Deep Water masses produced Besides parts of the Barents Sea, these lead sections are among the strongest dense water producers in the entire Arctic Ocean Conclusively, a combination of lead brine remixing (model A) and direct downward rejection of salt packages (model B) is assumed to steer the Laptev Sea dense water production Extreme events of dense lead water formation may be attributed to short-term (days to weeks) stormy freezing periods driven by permanent off-shore winds

HYDROLOGY OF THE LAPTEV SEA: SEASONAL AND INTERANNUAL VARIABILITY

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The data were analyzed concerning the salinity and temperature distribution in the surface and bottom water layers of the Laptev Sea in summer (August-September) and winter (March-May) since 1980 until 1995 The database includes measurements at 1260 summer stations and 936 winter ones The average multiannual temperature and salinity distributions and their root-mean-square deviations were calculated The data for every year were interpolated into the regular grid net with the help of inverse distance to a power method (power factor 2)

It has been found out that the interannual variability of the surface temperature and salinity distribution in summer is controlled by the river runoff In the coastal regions, the zones of minimum root mean square deviations of the surface salinity in summer mark the areas influenced by river runoff The main directions of river water spreading were established In the eastern part of the sea - from the Yana river mouth along the Yana submarine valley and from the eastern branches of the Lena delta to Stolbovoi Island Farther northward they flow between the Yana and eastern Lena submarine valleys In the western part of the sea - from the Anabar and Khatanga mouths along the Khatanga submarine valley up to the Maria Pronchishcheva Bay, and to the east from the Olenek mouth The least probable direction of the riverine water spreading is the central part of the sea The bottom relief governs the distribution of bottom temperature and salinity

In winter, the variability of surface salinity is governed by the existence of quasi-stationary flaw polynyas in the central and eastern Laptev Sea In the northern and northeastern regions, the zone of maximum root-mean-square deviations from the average winter salinity distribution coincides with the average multiannual fast ice edge position Its configuration follows the position of the Western New Siberian polynya In this case, the root-mean-square deviation of salinity ±1 - ±2 might be considered as the local salinization caused by intensive ice formation The average multiannual profiles of the distribution of thermohaline characteristics in summer and winter were calculated in the grid net along with the average multiannual values of the sum of freezing degree days recorded by the polar stations Dunai, Tiksi, Kotel'nyy The average ice productivity of the Western New Siberian polynya has been evaluated on the basis of these data and corresponding root-mean-square salinity deviation values For this purpose we used the simple Zubov's model The

estimated ice productivity for the end of April reached 4-5 m This correlates well with some of the existing estimations

In flaw polynyas due to the intensive local salinization at ice formation, convection may reach the seafloor thus causing the resuspension of bottom sediments The possibility of the down-to-the-floor convection was determined by comparison of the average winter salinity distribution in the surface and bottom water layers with corresponding root-mean-square deviations

THE ROLE OF HYDROMETEOROLOGICAL FACTORS IN THE INTERANNUAL VARIATIONS OF THE FAST ICE EXTENT IN THE LAPTEV SEA

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The influence of diverse hydrometeorological factors on the winter fast ice edge position in the Laptev Sea has been analyzed For the time period since 1979 until 1998, we used the following data the every-decade discharge at the downstream sections of the main rivers, air temperature, air pressure, and wind measured at 17 coastal hydrometeorological stations, results of the summer oceanographic surveys, and the every-decade complex maps of the ice extent in winter The authors invented and applied the method of basic directions which allowed them to determine the local fast ice edge shifts in relation to the variations of the local hydrometeorological parameters Statistical data analysis revealed that, beyond other factors, the river flood runoff determines the extent of the fast ice area during the next winter season It has been found out that in the parts of the Laptev Sea influenced by the river runoff, oscillations of the fast ice edge against the average multiannual fast ice edge position are out of phase with the interannual variations of the flood river runoff In the eastern Laptev Sea with a maximum interannual variability of the fast ice edge position, up to 70% of its dispersion is attributed to the quasi-two-year and quasi-three-year periodicity in the intensity of the river flood runoff The observed out-of-phase relationship results from thermodynamic processes related to the spreading of riverine waters in the sea, thus confirming the earlier supposition (Dmitrenko et al , 1999) about the negative influence of the river runoff upon ice formation in the shelf zone of the Arctic seas Regressive correlations have been estimated for several shelf regions that link the flood river runoff and the interannual variations of the fast ice edge position in winter

THE NEW VIEW ON THE ROLE OF FLAW POLYNYAS IN THE SIBERIAN ARCTIC SHELF ENVIRONMENT

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The system of flaw polynyas on the Russian Arctic shelf is an important component of the climatic system Continuous southerly winds blowing during the whole winter season are able to keep up large open-water areas (up to one hundred kilometers wide) off the fast ice edge Being combined with extremely low temperatures, this results in intensive ice formation and local salinization of the water column Sometimes the total thickness of the ice, formed in the Laptev Sea polynya during winter, reaches 12 meters (Zakharov, 1966)

Thus, the flaw polynya is the main source of ice for the Transpolar Drift It is also an important source area for saline shelf waters

Local salinization, caused by the rejection of salt during freeze-up, forms cellular circulation in the marginal part of the open-water area (Smith, 1973) The sub-ice water layer moves towards the open water, while compensatory currents in the lower part of the upper quasi-uniform layer flow in the opposite direction The zone of convergence exists in the open-water area A cellular circulation with a current velocity ranging from 2 to 12 cm/s has frequently been recorded in the winter leads (Smith et al , 1990, Morrison et al , 1992) Model calculations for free convection in the winter leads gave the maximum estimation of 8 cm/s (Smith and Morrison, 1993) Cellular circulation has not been recorded in the flaw polynyas though its possibility was predicted

In April-May 1999, the Russian-German TRANSDRIFT VI expedition carried out oceanographic measurements in the marginal parts of the Anabar-Lena and Western New Siberian flaw polynyas of the Laptev Sea For the first time in the Russian shelf seas, cellular circulation with extremely high current velocities was recorded at the micro-transect (5 stations, 450 m long) across the fast ice edge (coordinates of the basic station – 74°25'N, 130°22'E) The measurements were performed with the Three Dimensional Acoustic Current Meter (3D-ACM) produced by FSI, USA Close to the fast ice edge, the current velocity reached 61.9 cm/s in the 3 5 m-thick sub-ice quasi-uniform layer The compensatory current in the pycnocline down to the depth of 13 m equaled 24 7 cm/s The sub-ice current below the fast ice was directed to the open-water polynya, while the current in pycnocline was opposite to it Further observations showed that such circulation is typical of the marginal parts of flaw polynyas The horizontal size of circulation cells from the fast ice edge reaches 5 km The temperature characteristics of the pycnocline waters prove their convergent origin

(i) The existence of a quasi-stationary system of intensive baroclinic currents near the fast ice edge has absolutely changed our notion about the processes of heat-mass exchange through the pycnocline The estimation of the Richardson gradient number in the marginal zone of flaw polynyas at Ri<<1 5 gives evidence of an extremely effective turbulent exchange Previously it was thought that in the marginal zone of flaw polynyas, the heat transfer from the lower water layer to the surface was maintained by processes of convection and double-diffusion several orders of magnitude less effective (ii) Intensive surface currents flowing from the fast ice to the polynya may be responsible for the self-maintenance of polynyas with a size that does not exceed the horizontal size of circulation cells

THE OCEANOGRAPHICAL INTERACTIONS WITHIN THE SHELF SYSTEM OF THE LAPTEV SEA. THE MAIN RESULTS OF THE "LAPTEV SEA SYSTEM 2000"

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Oceanographic interactions exert a significant influence on the stability and evolution of marine environmental systems in the shelf zones of the Arctic seas They determine the dynamics of suspended sediments and their transportation by the ice, intensity of sedimenation and specific features of freezing processes These oceanographic interactions are noteworthy by their dynamic intensity in the Laptev Sea Field research work conducted in all the seasons of the year showed that they were mainly determined by two factors intensive river runoff in summer and the presence of a system of quasi-stationary flaw polynyas in winter These two phenomena initiate a broad spectrum of interacting oceanographic processes that determine the up-to-date state of the Laptev Sea environmental system

Oceanographic processes in the sea in summer and in winter are mainly determined by the river runoff The main trajectories of river runoff propagation in the Laptev Sea in

summer were determined on the basis of historical data and the data collected in the course of the TRANSDRIFT I-III, V, VII expeditions in the years 1993-1999 It was elucidated for the first time on the basis of direct current measurements that the horizontal water circulation in the surface layer is of geostrophic character, is controlled by a salinity field and determined by the propagation of the river waters on the sea surface The oceanographic interactions at the boundaries of this freshening zone cause a forming of high heat storage in the sub-surface layer The heat exchange with the surface exerts an influence on the freezing processes in autumn, the fast ice development in winter, and the processes of frazil ice formation

It was revealed on the basis of historical data and the data collected during the expeditions TRANSDRIFT IV, VI that the system of the quasi-stationary flaw polynyas in the eastern part of the sea determined the character of the oceanographic processes in winter The mean ice productivity of the flaw polynya was estimated as well as the penetration probability of convective mixing in the polynya region till the bottom The presence of a cell circulation at the ice edge of the polynya was instrumentally registered for the first time in the Russian Arctic seas These measured extremely high velocities of shear currents (up to 80 m/sec) completely change our notion of the vertical exchange character through density boundaries

The vertical structure of currents was studied on the basis of the annual course of the ADCP observations The obtained results completely change the existing notions of the barotropic character of the currents A clearly pronounced baroclinic structure both of the periodic and non-periodic currents determines turbulent regime of the vertical heat, salt, momentum, and suspension exchange through the density boundaries It is the reason of the frazil ice forming that is observed in the Laptev Sea in winter The redistribution of suspended matters in the water column is determined by the vertical current structure As for the other substances, the suspension exchange is significantly intensified by a development of shear instability caused by the baroclinic currents

$\delta^{18}O$ IN THE LAPTEV SEA, LAPEX 94

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The stable oxygen isotope composition ($\delta^{18}O$) in the Laptev Sea waters is mainly controlled by the riverine fraction and closely reflects a two source mixing configuration, covering a $\delta^{18}O$-range of about -16≈ to -1 ≈ SMOW with salinities being between 5 to 25 psu The riverine and high marine waters form rather well-defined end members as is shown by the closely linear relationship of $\delta^{18}O$ and salinity DIC (dissolved inorganic carbon) relates to salinity in a similar way Accordingly, salinity effects from sea ice processes, possibly evident in the relation of $\delta^{18}O$ (or DIC) vs salinity, cancel out in the $\delta^{18}O$-DIC-presentation and hence can be identified Such shelf brine waters were found in the Yana Bay and two other stations on the eastern Laptev Sea shelf

A NEW ICE CORE DRILLED ON ACADEMY OF SCIENCES ICE CAP, SEVERNAYA ZEMLYA - FIRST RESULTS

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The examples from Greenland and Antarctica demonstrate the excellent possibility of using ice cores for past climatic reconstructions In the Eurasian Arctic, the archipelago of Severnaya Zemlya is the most eastern one which is covered by a considerable ice cap, giving the opportunity to study regional climate signals from at least the whole Holocene period

The Academy of Sciences Ice Cap (Komsomolets Island) was chosen for a new deep ice core drilling because it is the thickest and coldest ice cap on Severnaya Zemlya Drilling started in May 1999 within a joint project of the Alfred Wegener Institute (Germany), the Arctic and Antarctic Research Institute, and the Mining Institute (Russia, St Petersburg both) The device used was the KEMS-112 electromechanical ice core drill, the same type used at Vostok Station, Antarctica

By the help of airborne radio-echo sounding data and SAR interferometry, a suitable drilling site (ice thickness 720 m) was found This season, the drilling reached a depth of 54 m The paper presents first results from the studies of snow pits, a shallow and the main core Visual stratigraphy, a delta-^{18}O profile and glaciochemical parameters show the glacier's peculiarity that results from summer melting processes Sharp signals obtained in the snow of the last winter layer were smoothed in deeper layers by infiltrating water Therefore stratigraphical observations are more difficult and probably seasonal signals cannot be expected

The amount of summer melting ice, detectable by optical stratigraphical studies or density measurements, is an indication for the mean summer temperature The correlation of summer melting ice with meteorological data will be discussed

Data from dielectric profiling (DEP) of the 54 m main core show considerable peaks in conductivity, which were interpreted as volcano events Following the resulting chronology, the drilled core represents the last 200 years, with a mean accumulation rate of around 220 mm w e a-1

MEAN ANNUAL GROUND TEMPERATURE OSCILLATION IN THE LAPTEV SEA REGION DURING THE LAST 400 KYR: METHOD OF PALEOTEMPERATURE CURVES COMPILATION FOR MATHEMATICAL SIMULATION OF TERRESTRIAL AND OFFSHORE PERMAFROST

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The isotope data derived from ice cores from Greenland and the Antarctic were used for plotting paleotemperature curves (Barnola et al , 1987, Kotlyakov et al , 1991, 1999, and others) In their basic traits, the Greenland and Antarctic isotope curves are very much similar and at the same time differ in some details In the similarity of these curves, the paleogeographers see the results of global climate changes, while the discrepancies seem to reflect regional paleogeographic peculiarities The reflection of global climate changes in the isotope curves allows their use for plotting paleotemperature curves for different regions of the globe The latter should be provided with reconstructions of paleotemperatures of climatic extrema and dated natural events of the past The authors of this paper used the isotope curve of the mean air temperatures derived from an ice core at the Vostok station to characterize the climate of the last 420 kyr It served as the basis for establishing the

direction of climate change (warming or cooling), the approximate time of the beginning, the duration and completion of these events Regional data from paleotemperature reconstructions were used as reference (benchmark) points for the transformation of the Antarctic paleotemperature curve into the regional curves for coastal lowlands and the Laptev Sea shelf

A number of reconstructions of the mean annual air and ground temperatures for the lowlands of northeastern Yakutia were published (Kaplina and Kuznetsova, 1997, 1998, Kaplina and Chekhovsky, 1978, Balobaev, 1978, Konishchev, 1997, 1998, Lavrushin, 1963, Ivanov, 1972, Kaplina et al , 1981, and others) All of them reconstruct the temperature deviations in the past from the modern ones and are used as regional reference temperatures Nowadays, the latitudinal zonality of the mean annual temperatures of deposits is observed in this region (Geocryology of the USSR, 1988) It was assumed that such a zonality existed in the past, too As regards the shelf, its exposures and floodings with sea, as well as the duration of the existence in the exposed and flooded states were estimated using the glacioeustatic curve and maps of isobaths All these statements and data were used for plotting the regional curves of the paleotemperatures of deposits for the lowlands and the Laptev Sea shelf

The results of the analysis of the natural conditions in the Sartanian and the Taz cryochrons, the Kazantsevo (Krest-Yuryakhsk) and earlier thermochrons (isotope stages 2 and 6; 5 and 9, respectively) are important for the system of reference data An analysis of the conditions of occurrence, cryolithological peculiarities (Romanovskii, 1958), and palynological data (Ivanov, 1972) shows the following During the cryochrons, the mean annual temperature of deposits decreased by 8 12°C, while during the thermochrons, it approached and possibly locally passed 0°C on land at 71° N This resulted in a shallow thawing of frozen layers not only under shallow lakes but also under the subaerial conditions

Technically, the curve of air and deposit temperature oscillations was derived by a computer-aided scaling of the Antarctic curve over benchmark points In the calculations of the temperatures of deposits from the reconstructed air paleotemperatures, the differences in the warming influence of the snow cover during the xerotic and hygrotic epochs were taken into account The curves of the paleotemperatures of deposits were plotted for two major modern landscapes in the lowlands and islands of Yakutia 1, Arctic tundras and deserts, 2, thin forests and northern taiga

FORMATION OF BAROCLINIC CURRENTS OF CONVECTIVE ORIGIN IN THE FLAW POLYNYA OF THE LAPTEV SEA

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During winter and spring, the flaw polynya is an active source of negative buoyancy (of mass and salt) in the seawater Thus, the density field (salinity and temperature) in the flaw polynya is transformed and intensive baroclinic currents are generated Open-water conditions and wind cause intensive frazil (dynamic) ice formation in the upper supercooled turbulent water layer (the layer of forced convection) Free convection develops at the lower boundary of this more salty and, hence, heavier layer due to the injection of brines into water at ice formation Free convection forms a 3D turbulent convective front Under different conditions, i e , at static vertical adfreezing of young ice on the flaw polynya surface, the 3D convective front is formed below young ice In both cases, this front spreads downward and interacts with either the sea floor (in case density stratification is absent) or the seasonal pycnocline Laboratory experiments showed that if the local Richardson number of the pycnocline $Ri=[g_0H_{iql}/(B_0R)^{2/3}]>10$, the latter may be viewed as a solid sea floor In this case, the 3D convective front slightly interacts with the seasonal pycnocline and spreads in the form of density intrusions beyond the limits of the polynya (the source of buoyancy) either to the fast or drift ice The initial local system of baroclinic currents is

formed near the fast ice edge It resembles the system of currents in fractures when a compensatory opposite current of lighter (less saline) water flows towards the polynya (the time of formation is about 1 day).

Later, due to the baroclinic instability of the convective 3D current (non-rotational) and the earth's rotation force, quasi-two-dimensional (2D) meso-scale vortices of convective origin are formed below the fast ice cover As a result, if the polynya exists for a long time (quasistationary regime>1 day) and young ice is formed, it becomes a vast intensive source of negative buoyancy This results in the formation of a meso-scale and mega-scale system of currents At a distance of several hundreds meters to several kilometers from the fast ice edge (local radius of Rossbi deformation or average diameter of 2D convective vortices), the current flow in the pycnocline and the bottom water layer is mainly directed along the fast ice edge and the polynya After dynamic adaptation, the current flow in the Upper Quasiuniform Layer (UQL) gains the same direction Near the fast ice edge, the UQL current has the local characteristics of a compensatory opposite current However, at mesoscale, its direction is rather at an angle or along the fast ice edge than transversely to it

The presented scheme of the formation and evolution of baroclinic currents in the flaw polynya has been supported by the observations of the density field changes and currents in the Laptev Sea polynya during the Russian-German expedition TRANSDRIFT VI in April-May 1999

COMPUTER TECHNIQUES FOR MEASUREMENT OF COAST RETREAT IN THE RUSSIAN ARCTIC

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The coastal zone of the Laptev Sea is a representative area for measuring Arctic shoreline retreat rates and coastal accumulation (accretion) processes The length of the continental Laptev Sea shoreline is over 4,900 km About one third of the shoreline (1,600 km) consist of an Ice Complex, i e , ice-rich deposits containing massive ice bodies which are subject to active marine erosion. Such areas were studied most thoroughly

Eroding shores produce a large volume of mineral material incoming to the sea The amount of such material may be estimated using the following methods

1) field measurement of the present shoreline and cliff morphometry,

2) comparison of shorelines and cliff tops on different-time topographic maps, satellite images, and aerial photographs

This method allows us to define the changes in shore morphology and geometry We used the software ENVI 3 0 (The Environment for Visualizing Images) to compare the maps and aerial photographs of the key sites in the central and eastern portions of the Laptev Sea coast ENVI 3 0 allows to superpose the scanned images quite precisely by mating a maximum number of key points selected on the compared images

The different-time aerial photographs (scale 1 30,000 - 1 50,000) overlay most precisely There is a sufficient number of topographic maps, aerial photographs for the studied sites and a limited number of satellite images However, remote sensing materials (maps and aerial photographs) are few for the 1990s Therefore field measurement of present-day coastal dynamics is necessary in addition to computer comparison of remote sensing data The changes of the shore outlines which took place in the last decades and in summer 1999 were introduced into the computer enhanced images based on the aerial photographs

Preliminary data are available on the Laptev Sea coastal erosion rate (2-6 m / yr) ENVI 3 0 can estimate an average rate of shoreline retreat and long-term trends of the Laptev Sea shore dynamics more precisely. The software can clearly show those portions of the coast which are subject to erosion or accretion

In 1999, field studies were conducted at seven key sites which represent eroding, stable, and accumulating shorelines The average coastal erosion rates were found to be approximately 1-7 m / yr The preliminary estimates and results of coastal processes analysis by ENVI-software confirm our earlier conclusion that the volume of the eroded coastal material incoming to the Laptev Sea is comparable with the sediment discharge of the major rivers

PALEOENVIRONMENT AND MODERN PROCESSES OF THE LENA DELTA REGION

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In this poster, we present results of the expedition LENA'98 which was carried out under the scope of the Russian-German project "Laptev Sea System 2000" During July/August, 1998, a total number of 30 Russian and German scientists, which were divided into three groups, focused on modern processes and the environmental history of the Lena delta

The first group concentrated on modern processes of permafrost soils, i e , the budget of methane and carbon dioxide, the influence of microbial communities and the water and energy flux in the active layer The field work included (1) the characterization of soils and selection of representative study areas, (2) the quantitative and qualitative analysis of carbon in relation to methane production, (3) measurements of greenhouse gas emission, carbon dioxide budget, and water and energy flux, and (4) sampling of permafrost soils

The second group focused on modern sedimentation processes in the Lena delta and its sedimentary and environmental history The field studies included (1) measurements of current and turbidity in the main channels of the Lena delta, (2) measurements of water level by automatic measuring sounds, (3) sampling of suspended material, (4) geomorphological studies, (5) sampling of sedimentary sequences by shallow-coring or through natural exposures, (6) ground penetrating radar and shallow seismic studies to identify sedimentary and permafrost structures within the Lena delta

The third group concentrated on paleoclimatic and paleoenvironmental reconstructions based on multi-disciplinary investigations of selected permafrost profiles Geocryological field studies of natural exposures and detailed sampling of permafrost sections for laboratory work were performed

CARBON-14 AS TRACER IN THE LAPTEV SEA

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River discharge into the Laptev Sea constitutes a key source for the Arctic freshwater budget This river water also brings large amounts of terrestrial carbon into the marine system, and the riverine influence in the Laptev Sea can therefore not only be followed by its $^{18}O/^{16}O$ but also by its carbon isotopic signature Using the accelerator mass spectrometry technique (AMS), we measured the ^{14}C concentration of dissolved inorganic carbon (DIC) and particulate organic carbon (POC) at selected stations sampled during TRANSDRIFT V The observed differences reflect the exchange between atmospheric CO_2 and marine DIC, including the uptake of the atmospheric ^{14}C bomb spike by the oceans,

the contribution of CO_2 and DIC from shelf sediments, and the input of both recent and old, reworked terrestrial organic material

MONITORING OF THE ICE COVER CONTAMINATION AND WATER SURFACE LAYER IN THE ARCTIC SEAS

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The results obtained by Russian and German researchers in the framework of the "Laptev Sea System" project and connected with investigations of contamination characteristics for drifting and land-fast ice are considered Russian historical data about the relationship between radiation parameters (integral and spectral albedo, back diffusion, etc) of sea ice and the intensity of the sea ice surface contamination, age characteristics, surface conditions, and destruction degree collected on the base of airborne and ground measurements in the Arctic seas are analyzed The actual physical mechanisms providing the relationship between the character, the intensity of the sea ice contamination within its formation period and the square of the seasonal ice cover distribution and also the sea ice destruction during the subsequent summer period are discussed The results of numerical experiments obtained using the climatic sea ice model, which illustrate the possible "catastrophic" subsequences of anthropogenic Arctic ice contamination, were presented The necessity of carrying out a special complex experiment, which will allow to combine the ground measurements of the sea ice contamination and surface radiation parameters with their diagnostic possibilities by remote sensing measurements, is discussed The defined relationships will allow to describe the sources and contaminant redistribution mechanisms due to the sea ice transport in the Arctic basin in more details

NEW DATA ON MACROBENTHOS IN THE NORTHERN PART OF THE LAPTEV SEA

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Lena Delta Nature Reserve, Tiksi

A large amount of data on the benthos distribution in the Laptev Sea was obtained during the ecological monitoring of the TRANSDRIFT expeditions (Gukov, 1989, 1991, 1992, 1996, Petryashev, 1994, Rachor, Hinz, Sirenko, 1994, Sirenko et al , 1995) After the expeditions TRANSDRIFT I-IV, an area without any hydrobiological data remained between 75°30' - 77°00'N and 114°00' - 130°00'E

In this paper, two benthos stations from the above area and two outside ones will be considered They were sampled during the TRANSDRIFT V expedition The area with depths of up to 60 m is characterized by parameters typical for the northern part of the Laptev Sea shelf (the salinity at the center of the investigated area (station YS9925) is 33 920, T°=-1 553°C) A bottom biocoenosis with the mollusk *Portlandia siliqua* (=*P arctica*) as indicator was found The composition of the bottom biocoenosis consists mainly of bivalve mollusks, amphipods, alcyonaria (*Gersemia fruticosa*), and brittle stars The dominant species are all adults, juvenile organisms are absent A similar situation was observed in 1998 at the periphery of the indicated area in the Anabar-Khatanga valley (station PS98159)

P siliqua is an index of the river runoff influence in the Arctic seas The benthic biomass in the biocoenosis has a wet weight of 44 6 g/m^2

Further south, we found a biocoenosis with Nuculana sp and Maldane sp as indicator species In this community, 45 macrobenthic species could be identified As a whole, species numbers are higher than on station YS9925 due to the occurrence of polychaetes,

hydroids, and mollusks The macrobenthos biomass has a weight of 60 g/m^2 and boreal-arctic species dominated

Station YS9931 is characterized by typical Arctic water masses with salinities of 33 979 and water temperatures of -1 721°C 31 species of mostly boreal-arctic origin could be identified on this station

The biomass in the relict river valleys is lower than in the adjacent regions In the valleys of Yana, Olenek, and Eastern Lena, the biomass tends to increase in a northward direction In the Anabar-Khatanga valley, the biomass is considerably higher (300-250 g/m^2 wet weight) in the southern and middle parts than in the northern one where it is relatively low with a wet weight of 40-50 g/m^2 To the east from the Bolshoi Begichev Island in the Anabaro-Lenskaya polynya district, the Yana valley is characterized by a biocoenosis with *T borealis* + *Nicania montagui* as indicator species and in the Maria Prontchisheva bay traverse, the biocoenosis is dominated by *Musculus laevigatus* + *Ophiocten sericeum* + *Nephtys longosetosa* + *Yoldia amygdalea*

BROADBAND ADCP TECHNOLOGY – THE FIRST RESULTS OF THE INTERANNUAL MEASUREMENTS IN THE LAPTEV SEA

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The current regime is the main factor governing heat and salt advection, the vertical exchange through the density interfaces, and the transfer of dissolved and suspended matter Until recently the information about the current regime in the Laptev Sea was based on the episodical measurements during the summer season The vertical structure of currents, their interannual variability, and influence upon the transportation of suspended sediments remained practically unknown

Within the framework of the Russian-German project "System Laptev Sea 2000", a joint expedition TRANSDRIFT V (ARK XIV/1b) was carried out aboard RV "Polarstern" in the Laptev Sea in August 1998 For the first time in the history of investigations in the Russian Arctic, two bottom oceanographic mooring stations equipped with Acoustic Doppler Current Profilers (ADCP) were installed for a long time period The northern YANA station was located on the eastern slope of the eastern relic paleovalley of the Lena river at the depth of 42 m This is the region of the average interannual position of the fast ice edge The southern Lena station was settled eastward from the Lena delta at the depth of 20 m in the region influenced by river runoff The stations were equipped with Self-Contained Broadband ADCP, model WH-S, 300KHz, produced by RD Instruments, USA Both stations were working for 13 months At the end of August 1999, they were successfully recovered by the joint Russian-German expedition TRANSDRIFT VII aboard RV "Yakov Smirnitskiy" During the period of operation, three-dimensional current velocity vectors and echo intensity were measured every 30 minutes at 1 5-2 m intervals from the surface to the seafloor

A preliminary analysis of the ADCP records allowed to conclude that echo intensity (D_I) is a good description of spatial (vertical) and temporal variations of the main reflectors suspended particles, zooplankton, frazil ice crystals, lower ice surface, and water (ice) – air interface The first results of the ADCP observations are given below

-the measured currents are periodical with the main period of 12 hours In most cases, the periodical component is sharply baroclinic Its spreading is discrete with a duration of 5 to 15 days Currents are mainly restricted to the pycnocline layer with a thickness of 10 to 20 m Their average amplitude is 20-25 cm/s, sometimes reaching 65 cm/s,

-the joint analysis of D_I and CTD distributions revealed that water layers with high D_I values usually coincide with the pycnocline,

-the shift instability resulting from the baroclinic character of currents at the pycnocline boundary causes an intensification of turbulent exchange During winter it results in the

bursts of active frazil ice formation lasting 2 to 12 days These bursts are well manifested by a sharp increase of D_1 in the sub-ice layer and usually correspond in time to the groups of the baroclinic internal waves passing in the pycnocline During summer, the instability of baroclinic currents is accompanied by the intensification of vertical exchange of admixtures through the pycnocline to the surface,

-summer storms are reflected by a high-frequency component in the changes of currents of the upper water layer above the pycnocline Storms cause the resuspension of the upper quasi-uniform layer by transferring suspended particles from the pycnocline to the overlying layer,

-the southerly bottom currents with a current velocity of 35-40 cm/s that were repeatedly recorded by the YANA station cause the resuspension of the 15-20-m thick bottom water layer,

-the daily variations of D_1 are well manifested in the surface water layer above the pycnocline during late autumn and early spring Minimum D_1 values correspond to the highest position of the sun above the horizon while maximum D_1 values were measured in night hours This is due to the daily migrations of zooplankton from the pycnocline to the surface for feeding during night hours

The first experience of long lasting ADCP measurements in the shelf zone of the Russian Arctic seas proved this technology to be the new step in oceanographic measurements The results of these measurements reflect diverse oceanographic processes and their interactions They allow to understand and estimate the dynamics of suspended sediments and admixtures which depend upon current regime and hydrophysical interactions related to it

RIVER DISCHARGE AND CYCLING OF TRACE METALS 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 Siberian rivers Yenisey, Ob, and Lena are ranked as 5,6, and 7 in the world, respectively in the order of annual discharge 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

These rivers flow through large areas of continuous permafrost and thus exhibit an Arctic nival regime with very low flows during winter and a pronounced spring high flow generated by snowmelt. The winter discharge of the Lena river can be as low as 366 m^3/s During winter, the concentration of dissolved solids exceeds 250 mg/l with sodium and potassium ions dominating calcium The concentration of suspended matter in the Lena delta during this time is low, showing characteristic values below 1 mg/l

The highest water discharge ever observed (194000 m^3/s at Kysur) occurred during the spring freshet in June 1944 A ten to twenty-fold increase in suspended matter concentration accompanies this up to a five hundred-fold increase in river discharge During June alone, about 35 percent of the total annual flow of the Lena river and more than 10 million tons of suspended matter (approximately 50 percent of the annual input) flow into the Laptev Sea This water enters the ice-covered SE Laptev Sea and forms a seaward prograding freshwater wedge under the fast ice

Even though, the spring freshet is obviously the most important period of the hydrological cycle of Siberian rivers which also dominates the fluxes of dissolved and particulate substances from land to the broad Arctic shelf seas, it is also the least investigated period Most of the published data on the transport of trace metals from the Lena river to the Laptev Sea cover only the period from July to early October This is also the major problem for the calculation of budget models for the riverine discharge of trace metals to the Laptev Sea Here we present the first calculations of riverine and coastal

fluxes of dissolved and particulate trace metals, based on new data covering all seasons (including the spring freshet)

THE ROLE OF THERMOKARST PROCESSES IN THE LAND-OCEAN INTERACTION IN THE LAPTEV SEA REGION

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The results of the Russian-German investigations within the projects "Laptev Sea System" & "Laptev Sea System 2000", the analysis of published and individual data, and mathematical computer modeling made it possible to estimate the role of thermokarst in the postglacial transgression and in the formation of the Laptev Sea shores

1 In the late Cenozoic, the Laptev Sea shelf was not subjected to glaciation but underwent, on the whole, an irregular tectonic subsidence The Laptev Sea shelf was subjected to regressions and transgressions as the result of glacioeustatic oscillations of the global sea level

2 During the last regression, the sea-water-saturated shelf deposits were frozen Syncryogenic ice-rich deposits of the "Ice Complex" (IC) accumulated on the exposed surface of the shelf reaching a thickness of up to 60 m and more in the internal part of the shelf in the subsiding tectonic structures.

3 Thermokarst lakes started presumably to form on the shelf and in coastal lowlands approximately 12 8 kyr BP (Bolling), 11-9 5 BP many lakes and alasses were already formed (Kaplina, 1981, Kaplina and Lozhkin, 1978) and partially drained At 11-10 kyr BP, the seashore was at the isobaths of 60-65 m at a distance of some 250-400 km from the modern shoreline Thus, the thermokarst lakes appeared in the middle and internal parts of the shelf before it was flooded by the sea

4 The thermokarst lake bottoms in negative tectonic structures were below the level of the transgressing sea Therefore, these lakes were transformed into "thermokarst lagoons" This increased dramatically in the indentation of the shoreline and accelerated the rate of thermoerosion of the shores At the same time, the lakes and lagoons served as traps for the washed-off deposits

5 During the period from 7.5 kyr BP until the present time, the seashore advanced in the southern direction by 250-150 km and formed the shallow gulfs of Buor-Kaya and Yansky and the straits between the Newsiberian Islands It should be emphasized that it was the most recent tectonic structural plan of the Laptev Sea shelf, accumulation of large thickness of the IC in the negative structures and the above-described IC degradation that determined the very fast rate of transgression in the Holocene and created the modern macro configuration of the shoreline of the eastern part of the Laptev Sea

6 The remnants of thermokarst-lagoon shores exist in the Bykovsky Peninsula and eastwards of the Yana River delta Cliffs with thermoerosion niches were formed in the basement of the most recent tectonic elevations This is exemplified by many shores of the Newsiberian Islands (Romanovskii, 1963) This is explained by the fact that the lower boundary of the IC, the bottoms of lakes and the surface of alasses are situated here above the sea level

The mechanisms described above can be demonstrated by examples from field studies carried out in 1998 and 1999 in the frame of the "Laptev Sea System 2000" project

MAIN FEATURES OF SPATIAL AND YEAR-TO-YEAR NON-TIDAL VARIABILITY OF LAPTEV SEA LEVEL DISPERSION

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It is well known that all previous investigations of the non-tidal sea level dispersion in Arctic and their year-to-year variability are based on the monthly (at least) mean data (Dvorkin, Mustafin et al.) One exception is a work which was made recently by Voinov and Zakharchuk (daily mean data in stationary approach) Here the significant contribution of variance was emphasized for the time scale of 1 year less It seems to be of interest to analyze the variability of non-tidal sea level variance for time scales within the range of 1 day - 2(3) month

Initial data were measured with 6-hour steps at the 9 meteorological stations arranged along the Laptev sea coastline during summer (July-October) 1959-1973 Tides were eliminated by filter technique Time series were splitted analogously to the bands (time scales) 30-80 hr (1-4 d), 80-300 hr (4 d -2 w), 300-720 hr (2 w -1 mo), >720 hr (1-2 5 mo)

Further estimations were focused to such topics as 1) spatial variability of variance ratio for adjacent time scales (seasonally (July-October) mean), 2) year-to-year and spatial variability for the main features of variance time series and varience ratio mentioned above that were obtained as a result of a non-stationary approach (sliding mode was used to calculate these time series)

It was revealed that predominant non-tidal sea level variance does not have a steady relation with some time scale from the ones chosen before Otherwise, this predominant variance was observed for all the time scales mentioned above for different groups of meteorological stations and different periods Generally, predominant variance was recorded for such time scales 300-720 hr (1960, 1967), 80-300 hr (1965, 1966, 1969), >720 hr (1963, 1964, 1970-73)

The main features for the seasonally mean variance ratio are for the ratio of oscillation variance within 80-300 and 30-80 hr always more than 1, maximum value areas are „shifting" during 1959-73 from the south central coast to the central part, absolutely dominates in 1965, then to the southeast, minimum value areas are „shifting" from northeast toward the south then to the west (1960-67), for the ratio of oscillation variance within 300-720 hr and 80-300 hr maximum value areas are „shifting" along the central part (1965-1966) to the northwest and east periphery (1969-1970)

The main features for variance time series are. the variance within the time scale of 30-80 hr the values of variance are stable from summer to autumn (probability 0 59, 0 72 respectively) during 1959-1964, 1969-1972, especially along the southwest, west, central part for the time scale of 30-80 hr The variance within the time scale of 80-300 hr increases from summer to autumn during 1959-1964 (0 58), this tendency absolutely dominates during 1965-66, 1973, then the variance is steady during 1968-72 (0 47) The maximum variance and stable variance segments of the time series for both time scales are most probable (0 63,0 59) within the middle of the first and the end of the third August decades

The main features for the ratio of oscillation variance within 80-300 and 30-80 hr tendency has absolute symmetry with respect to 1965 initially and finally (1960-1961, 1970-1972), this ratio was steady from summer to autumn, during 1962-1969 this one increases, for the ratio of the variances within 80-300 and 30-80 hr initially and finally variance ratio increases (1959-1960, 1971-1973), during 1961-1962, 1966 vice versa and in 1963-1965, 1967-1970, this ratio is stable, for the ratio of variances within >720 hr and 300-720 hr it generally increases but during 1959-1960, 1966, 1973 it is converse

ROLE OF THE FRESH WATER FROM LENA IN THE GLOBAL WATER BALANCE

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The Arctic Sea is believed to be one of the important elements in the water circulation of the planet The dynamic status of the Arctic Sea is dictated by a couple of driving forces, which the northbound-flowing Russian large rivers contribute to with their freshwater supply

This presentation does not give any results newly found, but intends to survey the programs in the possible extension of the project "Laptev Sea System" The Lena is not only a representative of the Russian large rivers, but is kept in her natural conditions The enlarged Lena basin is defined to extend to the shelf break so that the Laptev Sea is included in the Lena basin and the Yana, Khatanga, and other rivers are regarded as tributaries of the Lena

The mechanics how the fresh water drives the Arctic Sea will be investigated through the field study of the enlarged Lena basin in terms of the freshwater behavior in her "estuary"

INVESTIGATION OF RADIATION AND HEAT INTERACTION PROCESSES IN THE "ATMOSPHERE-ICE-WATER" SYSTEM IN THE LAPTEV SEA

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The main source of atmospheric movements is the irregular heating of the atmosphere by the sun and the irregular cooling to the open global space Heat and radiation exchanges between global space, surface atmosphere layer, and spreading surface (open water, snow, and sea ice) are fundamental factors of the climatic system

The physical processes occurring at the sea-ice-snow surface, in the snow-ice active layer, and in the ocean upper layer determine the energy exchange between atmosphere and polar ocean and are extremely essential to climatic study The spectral composition of solar radiation in a visible and near infrared range of wave lengths in the atmosphere, arctic waters, and ice-snow cover are determined by various meteorological conditions, the structure and physical properties of ice-snow cover, and also the sediment concentration in the water column Basically, the atmosphere represents a dispersing environment while absorption processes play a main role in the water The situation in the snow-ice cover are more complicated The investigation of these processes was the main task of the summer expeditions during 1994-1999

ICE, WATER, SEDIMENT AND UNDER-ICE TOPOGRAPHY: FACTORS INFLUENCING SYMPAGIC ORGANISMS IN THE LAPTEV SEA

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Organisms inhabiting Arctic sea ice itself as well as the ice-water interface are influenced by a variety of abiotic and biotic factors This includes new ice formation, growth and reconversion processes of the sea ice as well as current patterns, sediment load of water masses, and characteristics of pelagic communities under the ice In the course of the

biological and ice-related studies in the framework of "Laptev Sea System", the following features of this shallow shelf area have been described

o Biomass as expressed by integrated pigment concentrations varied considerably in the water column as well as in new and young ice samples
o The spatial distribution of microalgal taxa (diatoms, dinoflagellates, chrysophytes, chlorophytes) in newly formed ice and surface waters differed considerably between regions
o Near-bottom currents and near-bottom suspension maxima seem to foster not only high sediment concentrations but also an enrichment of benthic biological material, such as resuspended phytodetritus
o A high load of sediment as well as material of terrestric origin is included into new ice during ice formation and therefore altering habitat characteristics for sympagic organisms
o Underice topography is variable already in young ice
o On a larger scale, new ice formation and transport processes are more significant in the Laptev Sea as in other Arctic shelf seas

Based on the results of the TRANSDRIFT expeditions, the factors which have been identified as stucturing parameters in Arctic sea ice research will be presented and discussed regarding their relevance for the sympagic organisms in the Laptev Sea

TEMPERATURE AND HEAT FLOW MEASUREMENTS ON SUPPOSED SUB-MARINE PERMAFROST, LAPTEV SEA, NORTHERN SIBERIA

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During the RV "Polarstern" cruise TRANSDRIFT V, August 1998, within the German-Russian cooperation project "Laptev Sea System 2000", temperature measurements were carried out on the marine Laptev Sea shelf The water depth of measurements ranges from 25 - 1500 m to reflect the shallow shelf situation and the transition to deep sea environment Temperature profiles of up to 3 m depth were sampled at 42 sites

Preliminary results reveal a high positive heat flow in water depth of approx 1500 m, a negative heat flow in the intermediate water depth, and almost no significant heat flow in shallow water High heat flow values can be attributed to the rifting of the Laptev Sea, especially the East-Laptev Horst The negative heat flow values some 500 km off the recent coastline are interpreted as a strong indication of paleo-permafrost below the Laptev Sea

Insignificant temperature gradients on the shelf give hints to other active processes namely convection, diffusion, and oceanographic impact

ONSHORE AND OFFSHORE PERMAFROST EVOLUTION DURING THE LAST 400 KYR (4 CLIMATIC AND GLACIAL-EUSTATIC CYCLES): RECORDS OF PRELIMINARY MODELING

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Previous models of the formation of permafrost on Arctic shelfs and coastal lowlands were based on the assumption of the beginning of its aggradation after the Kazantcevoan interglacial (approximately 110-120 Kyr B P) (Romanovskii et al , 1997, 1998) Some authors (Soloviev, 1981, Fartyshev, 1993, Danilov et al 1998) suppose a younger age of the permafrost (from Kargan time 30 Kyr B P) But there are some reasons to think that

the permafrost in this region began to form at the end of the Pliocene and was never completely thawed

On the basis of isotopic curves from Vostok station (Antarctic) (Kotlyakov et al , 1999), the sea level oscillation and the dynamics of the mean annual ground temperature in northern Yakutia during the last 400 Kyr were reconstructed On the basis of this reconstruction, mathematical modeling of the permafrost evolution on the Laptev Sea shelf and Yakutian coastal lowlands was carried out A one-dimensional model, realized by the finite differences method (author G S Tipenko), was used This model takes into consideration permafrost zonation and different values of the geothermal flux in different geological structures For the recent shelf depending of the duration of permafrost, the aggradation and degradation at sea depth was also taken into account The process of sedimentation during this period was neglected

Our calculation shows that during the last 400 Kyr , there was no complete thawing of the permafrost Insignificant thawing from above could take place during short periods in the Lihvin (9-th isotopic stage) and the Kazantcevoan (5-th isotopic stage) time when the mean annual temperature exceeded 0°C Maximal values of the permafrost thickness are reached at the end of the middle Pleistocene (about 150 - 140 Kyr B P) The maximal decreasing of the permafrost thickness happened at the Lihvin and Kazantcevoan interglacial On the recent shelf, two areas can be selected Within the boundaries of the first (recent depths from 0 to 40 - 50 m), there is no complete thawing of permafrost during transgressions In the second (depths of more than 50 m), a replacing of the ice-bonded permafrost by the cryotic deposits under submarine conditions took place during transgressions

The recent thickness of the permafrost is decreased both on the shelf and coastal lowlands due to warming during the end of the late Pleistocene and the Holocene Decreasing of the permafrost thickness is caused by thawing from below due to geothermal flux. The higher the value of geothermal flux, the more the permafrost decreases It was noted for the first time that the differences of the permafrost thickness due to different values of geothermal flux increase during thermochrons in comparison with cryochrons For example at the end of cryochrons, the permafrost thickness due to a geothermal flux of 40 and 70mW/m^2 differs in 2 times, but at the end of thermochrons in 3-5 times

PRIMARY RESULTS OF PLANT MACROFOSSIL STUDIES FROM THE KEY SECTIONS "MAMONTOVY KHAYATA", BYKOVSKY PENINSULA: A CONTRIBUTION FOR THE RECONSTRUCTION OF THE LAPTEV ENVIRONMENTAL DEVELOPMENT

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Paleocarpological studies carried out on the Bykovsky Peninsula situated in the southeast of the Lena delta document a species-rich tundra-steppe like vegetation, existing during the Late Pleistocene The investigated exposure Mamontovy Khayata consists of so-called ice complex deposits, rich in well-preserved organic matter The carpological results, obtained from several selected horizons, reflect typical Late Pleistocene biocoenoses The species composition dominated by typical tundra plants is supplemented by steppe and mountain steppe elements as well as *Kobresia* and *Orostachys spinosa* Among the still occuring tundra plants, there predominated mainly pioneer plants, like *Potentilla* and diverse Caryophyllaceae preferring rather well-drained habitats Nevertheless, a mosaik-like distribution of both dry and wet locations is evidenced by the appearence of the submerged living hydrophyts *Potamogeton* and *Batrachium* besides the above mentioned steppe species The flora distinctly reflects the continental climatic character during the investigated time span, which correlates with the Middle Weichselian. Hence, the paleocarpological data confirm the results of geological studies concerning an emerged Laptev shelf in Pleistocene

times The species-rich flora of the investigated section is promising concerning the reconstruction of Late Pleistocene environmental conditions

MODELING OF SEASONAL HYDROLOGICAL CYCLES IN THE LAPTEV SEA

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The study of seasonal hydrological cycles in the Arctic seas is of great importance as these cycles form an inter-annual variability and serve as the basis for our understanding of climatic processes

The mathematical modeling of the evolution of ice and hydrological processes provides an effective means for the study of the ice and hydrological conditions of polar regions because of the insufficient amount of observational data

A coupled dynamic-thermodynamic ice-ocean model has been used for the reconstruction of the seasonal hydrological cycles in the Laptev Sea

The ocean block of this model includes the momentum balance equations, assuming the Boussinesq and hydrostatic approximations, the equations of incompressibility, state, heat and salt balance

To describe the internal ice stress term, we consider the ice as an elastic-plastic isotropic continuum

Ice thickness distribution is described by the introduction of partial concentrations (a fraction of grid cell covered by the ice of a particular thickness) We have chosen 6 thickness categories that correspond to the Russian standard ice age gradations Variations of the ice distribution function can be caused both by dynamic and by thermodynamic factors

The thermodynamic block of the model allows us to calculate energy fluxes at the upper and bottom ice surfaces, temperature profiles in the ice, depending on time, and ice thickness changes

The modeling of the seasonal hydrological cycles has been carried out for the years 1993-1994 well covered by observations

As a result of these calculations, fields of ocean currents and sea level for summer and winter seasons have been obtained, the influence of river water propagation has been estimated as well as the influence of the ice cover and atmospheric processes on water circulation

The calculation results demonstrate that the model adequately reproduces the main features of the variability of hydrological conditions in the seasonal cycle

STATIC AND DYNAMIC PARAMETERS OF ORGANIC MATTER TRANSFORMATION IN THE WATER COLUMN OF THE LAPTEV SEA

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The redistribution and transformation of organic matter are basic stages of the biogeochemical cycle of natural substances. We studied the processes of organic matter transformation in the water column of the Laptev Sea in July-September 1995 during the ARK-XI/1 expedition of the RV "Polarstern" 240 water samples were collected at 45 stations from the surface to the near-bottom layer (deepest one was 3400 m) The contents of total suspended matter (after filtration through Nuclepore filters with pore size of 0 45 mkm), chlorophyll and phaeophytin in the water column were determined as static

parameters The kinetic characteristics of the enzymatic destruction of the biopolymers of protein and polysaccharide nature were used as dynamic indexes

The peculiarities of the spatial distribution of static and dynamic parameters in sea water have been determined A correlation analysis of suspended matter and chlorophyll contents and the kinetic characteristics of the enzymatic destruction of biopolymers has been done The estimation of biopolymer destruction processes showed that effective organic matter transformation takes place mostly in the layer of 0-50 m, where the average enzymatic activity is equal to 158 enzymatic units, that is 8 times higher than in the 0-10 m layer and 2 4 times higher than in the 0-100 m layer

REGIONAL VARIATIONS IN THE ZOOPLANKTON DISTRIBUTION IN THE ARCTIC OCEAN: EFFECT OF BOTTOM TOPOGRAPHY AND CIRCULATION PATTERN

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Deep-water zooplankton sampling was carried out on the northern slope of the Laptev Sea and in two basins of the Arctic Ocean, the Amundsen and Makarov basins, on the transect across the Lomonosov Ridge during the joint German-Russian expedition ARK XI/1 of RV "Polarstern" in 1995 The aims of the study were to understand the effect of the bottom topography and circulation pattern on the vertical and horizontal distribution of zooplankton and to investigate possible effects of the recent changes in the intensity of the Atlantic inflow on the plankton ecosystem of the Arctic Ocean A comparison between the Amundsen and Makarov basins showed a very similar species composition of zooplankton on both sides of the Lomonosov Ridge indicating an effective faunistic exchange across the Ridge In contrast to species distribution, biomass showed a strong gradient along the Lomonosov Ridge transect, with a pronounced peak (9 5 g dry weight m-2) over the Ridge and minima over the deep basins The maximum was observed in the core of the Atlantic water west of the tip of the Lomonosov Ridge The elevated biomass (4 7 - 7 9 g dry weight m-2) was also observed near the Laptev Sea shelf margin with the maximum related to the core of the Atlantic inflow The values there were in a great contrast to the low zooplankton stock on the Laptev Sea shelf The present data indicate that the Atlantic inflow is the most important feature determining the distribution of zooplankton biomass within the Eurasian Basin, as it advects a large biomass from the Greenland and Barents seas There was no indication for a front east of the Lomonosov Ridge in the zooplankton data It is likely that the recent invasion of warm Atlantic water was associated with an invasion of Atlantic zooplankton into the Makarov Basin The relatively high biomass found during our study in this basin may have replaced the previous poor stock of the Canadian Basin This would imply a tremendous increase of zooplankton carbon considering the size of the Makarov Basin

NORTHERN CLIMATIC TREND

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The idea of arctic warming is widespread in society It is supported by the modern diminishing of large glaciers But there are many facts indicating an opposite climate trend First of all new small glaciers are being formed during the last decades in the arctic mountainous areas (e g , Kola peninsula, Taimyr, Chukotka) At not very high altitudes there occurs vegetation represented by mountain lichen tundras growing on well-developed soil with large incorporations of dead roots, which is characteristic of more luxurious

vegetation Such sites are usually situated along south-north wind directions Another observation which indicates the decreasing of mean summer temperatures in the Arctic is the progressive forming of new long-standing snow banks, which have still no surrounding specific vegetation typical for old snow banks It correlates with the movement of the southern tundra border inland and the penetration of more northern environmental processes, such as frost soil boiling, to the south even to the forest tundra The raising of the permafrost level leads to the intensive forming of bogs and ridge-pools and polygon complexes, the extinction of the marginal islands of northern forests and shrubs There are no saplings on the northern tree limits reached during the 1940s-50s The populations of the southern vascular plant species in the tundra zone are mostly rare and sporadic, independent of the proper habitats In the high Arctic, many plant species are disappearing though they lived there in glacier time when the shelves were dried up and the climate was more continental Arctic plant species are penetrating to the forest tundra and northern taiga, while southern species penetrate to the tundra zone mainly along the great rivers which carry not only diaspores but also warmth This penetrating of the southern elements to the tundra zone is rare, i e only single plants are met within the southern edge of the tundra zone

Thus many environmental observations bear witness to the modern Arctic cooling, not warming, at least in summer time which is most important for the biota This effect is more or less exhibited from the Kola to the Chukchi peninsulas, i e in the whole Russian north This can be caused by the increasing influence on the Arctic mainland in summer time of the Polar Ocean, which diminishes the quantity of summer warmth and enlarges the climate humidity In all northern regions, including the taiga zone, moisture is increasing during the last decades, which results in the swamping of the tundra, northern forests, and even more southern areas It is possible that Arctic cooling results from the northern moisture transfer due to the change of atmospheric pressure under the influence of the "greenhouse effect" in moderate latitudes

LUMINESCENCE DATING OF SEDIMENTS FROM ARGA ISLAND/LENA DELTA

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The age determination based on Optical Stimulated Luminescence (OSL) methods has become a powerful tool in Quaternary geochronology in the last decade The advantages of such techniques are the dating of the last light exposure (i e , transport and deposition) of sediment grains and a wide age range from several 100 to a few 105 years Nevertheless, the experiences in dating sediments from polar regions are relatively minor Difficulties can arise from insufficient light exposure and the problems of radiation field calculations for permafrost sediments

An about 5 meter sediment sequence at the south beach of Lake Nikolai / Arga Island was investigated Samples for luminescence dating were taken by drilling frozen sediment cores into light and water tight containers (diameter 5 5cm x 15cm length) The profile was cleaned before by melting and removing the frozen sediments several times

Potassium feldspar has been separated using a procedure of sieving, HCl and H_2O_2 treatment, feldspar flotation and density separation (2 53-2 58 g cm-3 / sodium-polytungstate) Finally the fraction 100-160 µm was etched with HF and HCl to remove the outer layer, affected by alpha-radiation The palaeodose has been determined using the Infrared Optically Stimulated Luminescence (IR-OSL) technique The dose response curve was recorded based on 48 potassium feldspar aliquots (4mg) for the natural and 6 additive dose values (irradiation by a Sr/Y ß-source, dose rate 0 91 Gy min-1) The samples were

stored for 3 weeks at room temperature after irradiation and preheating (140 °C, 2 d) was performed before the IR-OSL measurement (880 nm stimulation, 410 nm detection) 100 s IR-OSL decay curves have been used for data evaluation, combined with natural signal normalisation and saturation-exponential curve fitting The calculation of the natural sediment dose rate is based on High Resolution Gamma-Spectrometry radioisotope analyses (U, Th, 40K), spectral radiophosphorescence analyses of the feldspar (internal 40K), cosmic dose rate calculation, and the ice/water content of the sediment

The IR-OSL age data obtained from the Arga sediment sequence will be presented and discussed in methodological and geochronological context

SNOW PATCHES OF KHAPTAGAI TAS (BOL'SHOY LYAKHOVSKY ISLAND) - A CASE STUDY OF PERIGLACIAL PHENOMENA AND A POSSIBLE EXPLANATION OF ICE COMPLEX GENESIS

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Satellite pictures of the hills of Khaptagai Tas south east of the Bol'shoy Lyakhovsky Island show a continuous occurrence of snow patches over some years until August In order to study the area of these snow patches, a three days trip took place during the Russian-German Lyakhovsky expedition in summer 1999 However, this year there were no snow patches at all on Khaptagai Tas hills Anyway, it was possible to study the specific periglacial geomorphologic structures, the zonality of deposits in the snow patch area, and surface and sediment phenomena in the snow patch location

The entire study area is located between the coast of the Dimitry Laptev Strait in the south, the Khaptagai Tas hills in the north, and between the river Vankina in the west and the Dymnaya river in the east In a distance of about 15 km from the sea, the country surface gradually rises to the hills of 200 m a s l Surface structures are dominated by a net of thermo-erosional valleys as small bottom valleys (Russian log) and separate gullies (Russian ovrag) and thermokarst Thermodenudative alas depressions occur only near the sea

The slopes of the Khaptagai Tas hills are form-superimposed by cryoplanation terraces The hills are covered by meter-sized granite blocks, which become rare towards the feet of the slopes Pebbles of sandstones and slates were found in larger distances in fluvial deposits The hills of Khaptagai Tas are part of a mesozoic granite intrusion within Permian sandstones and slates Large kar-like formations with features of repeated snow patch positions occur in positions where the snow patches were located on the northern and southern slopes

A gradual enlargement of surface sediments is visible when approaching the hills The surface material of larger distances consists of loamy, silty fine sand without any small stones or gravel But near the hills, the frequency and size of stones in the dominating fine-grained silty material increase gradually Most of the granite blocks are covered by black lichens Only stones on the snow patch locations show a light gray colour without black lichens Many wet sediment patches occur between the granite blocks They are overgrown by various plants and contain a lot of fine roots This sediment looks like the fine-grained rooted material of the Late Pleistocene ice complexes (Russian alevrit)

Snow patches are possibly more important for the genesis of the Quaternary ice-rich permafrost deposits of Northern Middle Siberia than presumed until now A number of geocryological phenomena described in the Ice complex and the underlain older Quaternary deposits are found again in the area of snow patches of Khaptagai Tas

LANDSCAPE STRUCTURE OF THE LENA DELTA AS AN INDICATOR OF METHANE FLUXES

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Field studies of the modern processes occuring in the permafrost-affected soils of the Lena delta were carried out during the last two years Samoylov Island, which is a representative monitoring site, is located in the apex of the delta on the level of the Holocene first fluvial terrace The intensity of gas fluxes is dependent on local landscape and permafrost conditions, which were studied in 1999

When estimating the total carbon budget (CO_2, CH_4) in the region, it is necessary to take into account the contribution of buried organic material and fossil ice exposed during the spring flood The investigation included the detailed sampling of the organic profile and the ice wedges on Samoylov Island The field work resulted in a map reflecting the landscape structure, geomorphology, and permafrost features of the island The investigated landscapes are typical for the Arctic system They formed on the vast territory of the first fluvial terrace of the Lena delta and occupy near one quarter of its area It was found that methane fluxes in the main structural elements of tundra landscapes as well as lake and coastal landscapes vary significantly The major conclusion from the field study is that the dynamics of carbon fluxes (CO_2, CH_4) in the Lena Delta is determined by landscape structure, climatic changes, and a hydrological factor

THE EFFECT OF VEGETATION ON METHANE FLUXES FROM WET POLYGON TUNDRA

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High-latitude wetlands are one of the major sources of atmospheric methane, which are estimated to contribute 3-20 % of the total global methane emission Plant-mediated methane transport, which bypasses the aerobic soil zone of methane oxidation, is well described as an important process in methane fluxes for different wetland ecosystems including tundra sites in Alaska Little is known about the ecological processes concerning the methane fluxes from the enormous area of Siberian arctic wetlands

Within the scope of the project "Laptev Sea System 2000", the effects of vegetation on methane fluxes were investigated in August 1999 on the island Samoylov, which is situated in the southern part of the Lena delta (N 72°, E 126°) Daily measurements of methane emissions and the important abiotic controlling factors were done on a permanent site on the area of a low-centre polygon The vegetation was dominated by Carex concolor (20-50 % coverage) in the polygon centre and by mosses (80 % coverage) on the polygon apex The soil of the centre was classified as a Ruptic Historthel and the soil of the apex as a Glacic Aquiturbel The total methane emission from the site and the release of methane through individual tillers of Carex concolor were analyzed and related to each other Closed chambers (50 cm x 50 cm x 5 cm) were used for the measurements of total methane emission For the determination of plant-mediated methane emission, self-constructed chambers (0,5 l and 1 l) were used, which could be fitted around individual plant tillers Due to the differences in water table position and thaw depth, the total emission ranged from 3-10 mg CH_4 d-1 m-2 from the polygon apex to 16-50 mg CH_4 d-1 m-2 from the polygon centre Emissions through individual tillers of Carex concolor ranged from 8-26 µg CH_4 d-1

on the apex to 38-236 µg CH_4 d-1 in the centre The calculated plant-mediated methane emission accounted for 74 ± 19 % of the total emission from the centre and for 27 ± 10 % of the total emission from the apex of the polygon A strong correlation was found between the stocking density of Carex concolor and the emission of methane (r = 0,87), showing the role of vegetation as a major control on the spatial variability of the methane emission from a wet polygon tundra

THE LATE PLEISTOCENE FAUNA OF THE LAPTEV SHELF GRASSLAND: INSECTS AND MAMMALS

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The paleontological research of perennially frozen sediments along the Laptev Sea coast, in combination with a complex of multidisciplinary studies, allows a new insight into the environmental history of the shelf land during the Late Pleistocene regressive stage and the dramatic restructuring of its fauna and landscape at the Pleistocene/Holocene boundary

During the work of the Russian-German team at the Bykovsky Peninsula in 1998, twenty-five samples with insect fossils have been collected in Mamontovy Khayata (MKh) - the key section of the Late Pleistocene Ice Complex (IC) The samples of an average weight of 30-40 kg were screened and later processed according to standard technique Many samples yield rather rich and ecologically representative insect fauna Their study allowed to identify more than 60 insect species In the MKh section, where the IC thickness reaches 40 m, the interval of 11 to 19 m a s l was subjected to the most dense sampling (16) The interval between 20 and 29 m a s l has only four representative samples In the upper part of the cliff, only one sample is available (at 37 m) These collecting biases were compensated in 1999 when nine samples were screened from the upper part of the section (25-35 m a s l.) All the studied insect fossil assemblages have much in common They all are dominated by insects of open treeless environment, currently living in the tundra with various degrees of humification - from damp to very dry - and steppe zones The species, currently restricted to the taiga zona, are almost absent However, many of the recognized ground beetles (Carabidae), currently occurring in the tundra, are rather thermophylic, and their main modern ranges are in the taiga zone An interesting feature of the MKh insect assemblages is the essential (sometimes dominating) role of willow weevil Isochnus arcticus, described in the modern fauna of Wrangel Island

Despite this general similarity, the fossil assemblages vary in the representation of various ecological groups, and these variations can be used for the analysis of environmental changes The sequence of 16 most representative samples allowed to recognize seven stages of landscape evolution The earliest known assemblages (ca 45 ka and older) demonstrate the highest share and diversity of various steppe elements, the total contribution of which sometimes approaches 50% of the whole sample (in the minimum number of individuals present) Upward in the section, the share of the steppe group becomes notably lower, with the most cold-resistant species of this group remaining (age interval ca 45-35 ka) The most mesic assemblage is found in the middle part of the section It is dominated by a species of the damp tundra, with a few taiga insects and very few steppe ones Higher up the section, the "coldest" tundra assemblages are known, dominated by I arcticus, and including almost no steppe species The latest Pleistocene assemblage from the Bykovsky IC (ca 12 5 ka) is dominated by xerophylic tundra species, with a notable contribution of steppe insects

Two field seasons (1998-99) of fossil mammal research at the Bykovsky Peninsula resulted in one of the largest collections of the Late Pleistocene fauna in the whole Arctic About 900 bones were identified, mostly in the MKh area. Nearly 160 bones were found within the main MKh exposure (the cliff sample) About 550 specimens were collected on

the beach and sand bars adjacent to MKh (shore sample) Finally, 150 bones come from taberal deposits of an alas section (Kuznetsova et al , this volume)

Nearly 40% in both cliff and shore samples belongs to woolly mammoth In the cliff sample, the second place after the mammoth is shared by reindeer and Pleistocene hare (15% each) Only these three species were found in strict in situ positions Extinct horse and bison bones, found within the cliff, build 11% and 4% respectively, but in the shore sample, their share is notably higher (22 and 12%) In general, this is a complex of herbivorous mammals, rather typical for the Ice Complex, but in the proportion between the most common species, it differs from the other known sites

Conventional ^{14}C dating of bones from this collection has been undertaken in the Geological Institute RAS. Forty dates, issued at present, already make a unique number of dated bones from one locality Twenty-five dates on mammoth bones cover the time range from more than 45 6 ka to 14 3 ka There are no dates between 23 0 and 14 7 ka It is known, however, that the mammoth did live in the Laptev area during this time span The ages of 15 0 and 20 1 ka have been earlier obtained for mammoth bones from the Shirokostan Peninsula, 15 4 and 19 9 ka - from Kotelnyy Island, 18 5 and 20 9 ka - from Faddeyevsky Island, and 21 6 ka - on the mammoth bone, found in situ in the MKh section itself Thus, we currently ascribe the gap in the dating series in MKh to taphonomic reasons or collecting bias

Both insect and mammal assemblages evidence that during the Late Pleistocene, the Laptev shelf hosted rather rich fauna, which inhabited a kind of grassland with relatively high summer heat influx to the surface

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THE FAUNA OF ALAS SEQUENCES IN THE ICE COMPLEX AREA: THE CASE OF MAMONTOVY-BYSAGASA NORTHWEST EXPOSURE, BYKOVSKY PENINSULA

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The paleoecological study of alas (thermokarst depression) sections, extremely widespread in the distribution area of the Ice Complex (IC), is of primary importance for the reconstruction of the chronology and sequence of the major environmental changes that occurred in the Arctic around the Pleistocene/Holocene boundary One of such sections was studied at the Laptev Sea coast, in the east-central part of the Bykovsky Peninsula It is located within the Mamontovy-Bysagasa (MB) alas, a large thermokarst depression with lakes and creeks, elevated for 4-10 m a s l The alas is adjacent to yedoma hills up to 40 m high and is abraded by sea as well as the hills The cliff of the SE hill is the key section of IC (Mamontovy Khayata) The coastal exposure of the terrace-like surface (7-10 m a s l) at the NW edge of the MB alas reveals that its section includes two different units

The upper unit, up to 3 5 m thick, is built by silt and sand, rich with various plant remains, and includes narrow ice wedges The silty upper member of this unit (2 m) has numerous inclusions of autochthonous peat, "hummock-like" in shape One of them (depth 0 8 m) has been dated as 5316±193 y BP (PI-1999) (conventional ^{14}C, non-calibrated) The lower member is built by fine sand and includes many various parts of large shrubs, sometimes with bark (shrub alder and birch), and tree logs and stumps (larch?), some of the latter in life position This member also contains shells of freshwater bivalves and gastropods Thick branches and roots showed conventional ^{14}C ages of 9067±230 y BP (PI-1181), 9443±242 y BP (PI-2000) and AMS date 9475±40 y BP (KIA 6739) The lower unit (visible thickness 5 m) is built by compact grey silt with lenses of fine-grained sand and plant detritus By the cryogenic features, this unit is considered as taberal - thermally

transformed deposits, presumably of IC, thawed in place (without redeposition) and later refrozen

This assumption is confirmed by the composition of fossil insect assemblages from this unit Four samples are similar to each other and to the Late Pleistocene assemblages, known from the middle part of the Mamontovy Khayata Ice Complex section (MKh) They are dominated by mesic tundra species, with an essential role of dry tundra inhabitants and the presence of steppe species The insect assemblages from the upper unit (3 samples) are very different Insect fossils are more numerous here, have better preservation and much higher diversity The sample from the "wood" horizon is peculiar for the presence of forest insects The northward advance of trees and tall shrubs to the Bykovsky Peninsula in the Early Holocene, 9-9 5 ka (non-calibrated ^{14}C age) can be correlated with the regional thermal optimum However, the presence of steppe insects, characteristic of Pleistocene tundra-steppe assemblages, in all samples from the upper unit suggests that the Early Holocene plant communities were not analogous to modern ones

More than 150 fossil bones of mammals have been collected on the beach under the NW MB cliff They all belong to common late Pleistocene species (mammoth, horse, reindeer, bison), but have a preservation different from those from the IC (darker surface coloration, vivianite), that seemingly indicates their alteration during the matrix sediment thaw and indicates that they come from the taberal unit Eight ^{14}C dates on mammoth, horse, and bison bones range from 39 2 to 28 7 ka, which corresponds to the dates from the middle part of the MKh section Although the absence of younger dates may be caused by a small sample size, their close grouping may suggest that this age range is not coincidental

The results obtained from the NW MB and MKh sequences allow to suggest the following scenario The accumulation of IC probably terminated around 12 ka This is evidenced by the AMS dates from the uppermost level of IC in MKh - 12,525±50 y BP (KIA 6718) and 12,355±50 y BP (KIA 6719), accompanied by the typical Pleistocene insect assemblage, and the date 11,090±270 y BP (NUTA-2231) from the organic layer, overlying IC (Fukuda, 1994) Thus, the denudation of IC and the development of thermokarst kettle could have started around 12-11 ka The large lake in the MB alas was probably an open system, with the outwash of silt material It existed until about 10-9 5 ka At the time of the Early Holocene optimum, the alas bottom (or at least its peripheral part) was overgrown with shrubs and trees This stage was accompanied (or followed) by the freezing of the sub-lake talik, while the accumulation of deluvial-solifluction and paludal sediments continued until about 5 ka During the second half of the Holocene, further deepening of the alas took place, possibly related to the creek outwash to the sea Except minor details, this scenario correlates well with the regional pattern of the alas development in Northern Yakutia (Kaplina & Lozhkin, 1979) and can be extrapolated to countless similar cases.

ONSHORE AND OFFSHORE PERMAFROST IN THE GREAT LAKES AREA OF THE NORILSK REGION

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The Norilsk region great lakes cover an area of up to 466-850 km^2 and maximum depths from 25-34 m (Melkoe and Pyasino Lakes) to more than 254 m (Lama Lake) During 1991-1993 and 1997, the geocryological conditions within two key sites located within the western coast of the Lama Lake (the northwestern Putoran Plateau) and within the northern coast of the Pyasino Lake (the southern Taymyr Lowland) were characterized using different techniques

The plain part of the study area is located within the zone of continuous and discontinuous (southward to Pyasino Lake) permafrost of up to 100-150 m in thickness The mean annual ground temperature (t_g) ranges from - 5 to -9°C in the north to -1,5 to -1 8°C and low positive values in the south In the study area, a combination of many local factors (microrelief, vegetation, snow cover, variations of physical and thermal ground

properties, etc) defines the wide range of t_g values as well as of an active layer thickness Peat seasonally thaws up to a depth of 0 2 - 0 4 m, fine deposits to 0,5-1,3 m, well-drained coarse deposits to 1,5 m and more. Different cryogenic processes and phenomena such as frost cracking and ice wedges, buried massive ice bodies, sorted polygons and medallion-spots, thermokarst, solifluction, etc are widespread

Taking into account the large water table area and the great depths of the great lakes, one may assume the existence of open talik zones under the lakes But vast shoals are typical of these lakes Thus, the configuration of sublacustrine taliks may be fairly complicated The great flowing lakes (Lama, Melkoe, Pyasino) are characterized by an annual water level fall from 3 5 m (Lama) up to 5 m (Pyasino) Therefore periodic draining of the extensive area of coastal sites and water freezing to the bottom on the shallow water areas occur Field off-shore permafrost study is very complicated and so computer modelling was performed The modelling, based on a natural regionalization of the lakes, was carried out to determine the t_g values, the area of offshore permafrost distribution, and its thickness under the lakes

As a result of the modelling, it is found that, without reference to the fact that thawed or perennially frozen ground is distributed at the lake shore, perennially and seasonally frozen ground is formed at the lake zone of the water level fall (ZWLF) The frozen-and-thawed-ground interface in the plan is found at various distances from the shore depending on the lake bottom inclination, the speed of the water level fall in the winter, the thickness of the ice covering the draining coast, the thickness and density of the snow on the ice The closer to the shore, the lower t_g, but the greater the seasonal thawing depths The permafrost thickness at ZWLF depends on t_g on the shore, and the lower t_g, the thicker the permafrost In case of thawed ground distribution on the shore (for the Melkoe and Lama lakes), the permafrost thickness at ZWLF is 60 - 140 m and permafrost enters in the form of aprons inside the shore

The modelling results show that permafrost should occur under a significant part of the Pyasino and Melkoe lakes as well as under the western part of the Lama Lake By drilling, permafrost (more than 10 m thick) was found under the shallow southern part of the Pyasino Lake and under a large bay of the Pyasino river The values of t_g under the lake bottom are much lower compared with those near the shores

Permafrost, especially discontinuous, is very sensitive to environmental changes The present-day permafrost features began to form mainly since post-glacial times and the lake level fluctuations were of great importance In the Late - Post-Zyryanian period, the dammed so-called Valek Lake spread within a vast area to the border of the Putoran Plateau Its level was at least 60-70 m higher than the present Pyasino Lake level A field study of the deposit sequences in the Lama Lake shores gave some additional records about the existence of a vast ancient lake in the end of the last Melkolamsk stage of the Sartan glaciation (10 7-11 4 kyr B P) Traces of a significant lake level rise in this time were found Significant lake level fluctuations during the Late Pleistocene and Holocene influenced the onshore and offshore permafrost features leading to a decrease of the permafrost thickness at the lake level ascending stages and to permafrost appearance at widespread terraces now belonging to the lake, and to lake shoals during the lake level descending stages Holocene lacustrine sediment freezing was accompanied by frost heaving and creating a specific type of the present topography such as frost mounds

For the Norilsk region, one of the main future problems is associated with an increase of the water level due to global warming or any another reasons Now the sediments of the southern Pyasino Lake take and conserve by permafrost the most part of heavy metals and other contaminants from Norilsk industry In case of a water level rise, permafrost will be reduced and these contaminants will be carried away via the Pyasina river into the Arctic Ocean

PALEOCLIMATIC CHANGES IN THE LATE QUATERNARY - EVIDENCES FROM STABLE ISOTOPES AND HYDROCHEMISTRY OF GROUND ICE OF THE BYKOVSKY PENINSULA, NORTHERN SIBERIA

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This poster focuses on ground ice studies carried out in the multidisciplinary research program "Paleoclimate signals in ice-rich permafrost" in the Laptev Sea Region (LSR)

Until now, the reaction of permafrost to natural climatic changes is insufficiently understood. The application of deuterium and oxygen isotopes for paleoclimate studies in ice bodies is well known as one of the best tools for paleotemperature reconstruction and for the identification of the source of the precipitation The best climatic archive in polar regions is glacier ice In polar regions without Pleistocene glaciation, like the Bykovsky Peninsula, 50 km SE of the Lena Delta, Northern Siberia, the ground ice and especially ice wedges can be used for paleoclimate reconstruction

As known, ice wedges are fed by meteoric water sources and can therefore be deciphered by the stable isotope method Big mostly syngenetic ice wedges grow principally by frost cracking and the freezing of meltwater of previous years' winter precipitation and reflect mean annual winter temperatures We applied a most detailed sampling of ice wedges for the stable isotope analysis covering the whole period of ice wedge formation The sampling resolution (10 cm horizontally) probably corresponds to time intervals less than 100 years when assuming frost cracking as an annual process

The combination of hydrogen and oxygen isotopes considerably extends the possibilities of the method Our studies focus mainly on very ice-rich sequences with huge polygonal ice wedge systems formed during the Weichselian and the Holocene periods in wide areas of Northern Siberia For comparing past and present conditions, young (this century) ground ice was additionally identified by tritium analyses

In order to obtain further paleoenvironmental information and a better characterization of the ground ice, different generations of ice wedges were sampled a Late Pleistocene to Early Holocene ice wedges (58 – 8 ka) in the ice complex, b Holocene ice wedges (1 – 3 ka) in alas deposits, c. Holocene ice wedges (about 1 ka) in deposits of a shallow small stream, d modern ice wedges These ice wedges of different generations can be distinguished by means of their shape, color and size, by stable isotopes (∂D and $\partial^{18}O$), tritium, hydrochemical parameters (pH, electrolytical conductivity, major ions) and ice structural analysis by means of polarizing lenses First results of last year's expedition to the Bykovsky Peninsula show changes in the climatic character throughout time pointing to differences in winter temperature, humidity, and continentality

INPUT OF TERRESTRIAL ORGANIC CARBON INTO THE LAPTEV SEA DURING THE HOLOCENE - EVIDENCE FROM STABLE CARBON ISOTOPES

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Stable carbon isotope studies of surface sediments and sediment cores of the Laptev Sea shelf were carried out 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 provides an attractive tool to assess the contribution of terrestrial organic matter discharged by the Siberian rivers onto the Laptev Sea shelf The $^{13}C/^{12}C$

ratio of organic matter in marine sediments has been utilized to estimate the relative amount of organic matter derived from terrestrial and marine sources

The $\delta^{13}C_{org}$ signature of the surface sediments ranges from -26 6 ‰ vs PDB near the coastal margin to -23 ‰ in the north towards the outer shelf The lightest values of $\delta^{13}C$ occur near the mouths of the Lena, Yana, and Olenek rivers This low $\delta^{13}C$ signature gradually declines northward and along the submarine river valleys Topographic highs on the shelf area reveal a tendency to isotopically less depleted signatures, ranging between -24 8 ‰ and -25 2 ‰ vs PDB For a relative quantification of the terrestrial input, a two-component mixing model is used The end members are represented by a terrestrial and a marine component and each is characterized by its typical isotopic signature Using this model, it can be shown that the terrestrial influence represented by light carbon isotope signatures reaches further north in the eastern than in the western part

Downcore studies of the $\delta^{13}C_{org}$ and TOC records, measured on three marine sediment cores from water depths between 46 m and 77 m, controlled by ^{14}C age models are used to infer the temporal changes in the pathway of the terrestrial organic matter supply to the mid shelf during the past 13 kyr Due to the postglacial sea level rise, the Laptev Sea shelf became widely flooded During this period of time, this process caused large-scale coastal erosion with an increasing dispersal of terrestrial organic matter on the shelf areas As recognized in the $\delta^{13}C$ record and in the accumulation rates of TOC, the maximum input of terrestrial organic matter on the mid shelf occurred between 9 and 7 cal ka BP, a time that presents the main transgressional phase. After 7 ka BP, a period of relatively low accumulation and isotopically heavier $\delta^{13}C_{org}$ signature began This probably marks the time when the sea-level rise reached its Holocene maximum and more marine conditions similar to the present were established on the Laptev Sea shelf

THE LATE CENOZOIC EVOLUTION OF THE LAPTEV SEA SHELF

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The poster is largely based on the results of the geomorphological and seismic acoustic studies on the Laptev Sea continental margin as well as the coring data and materials of shallow drilling on adjacent islands, mainland, straits of the New Siberian Islands archipelago, and the shallow bays of the southern part of the shelf The most remarkable geomorphological feature is the system of ancient paleovalleys of fluvial paleochannels (of the Khatanga, Anabar, Olenek, Lena, Yana rivers) cutting the margin up to the shelf break It is located at the average depth of 70-100 m Numerous submarine canyon heads occur on the continental slope as prolongations of these lower courses of ancient river paleovalleys Four stratigraphic units are recognized in the upper part of the sedimentary cover Upper-Miocene-Pliocene, Eopleistocene-Mid Pleistocene, Upper Pleistocene, and Holocene The first unit overlapping the regional reflector "L" is composed by alluvial, deltaic, and shallow marine deposits Lower-Mid Pleistocene sequences include predominantly marine and glacial-marine deposits overlayed by the Kazantsevsk (Eemian) marine subunit It underlays a glacial fluvial, alluvial, and shallow marine Weichselian sequence. The uppermost veneer of bottom sediments is contributed by Holocene marine deposits The average thicknesses of the Upper Miocene-Quaternary sediments vary from 0-20 to 200-300 m while Holocene deposits are up to 10-20 m thick The maximal thicknesses of the Upper Cenozoic cover are established within inherited grabens and trenches of the Laptev Sea Margin rift system occurring between the Gakkel mid ocean ridge penetrating the continental rise and Buor-Khaya Bay Within shelf highs and uplifts, the Upper Cenozoic cover thicknesses are usually significantly reduced The maximal Late Pleistocene glaciation of the Central Siberian mainland took place during the Early Weichselian time when the shallowest parts of the western Laptev Sea shelf adjacent to Taimyr Peninsula and the Severnaya Zemlya archipelago were probably covered by an ice sheet while the eastern parts of the shelf were obviously free of ice and thick permafrost (up to several hundreds of m)

had been formed there During the last major regression of the Late Weichselian epoch, the whole shelf was exposed and the intricate systems of the paleovalleys of fluvial origin had been worked out on the continental margin

PALYNOLOGICAL RECORDS FROM THE LAPTEV SEA SHELF PROVIDE EVIDENCE OF HOLOCENE CLIMATE CHANGE

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Palynological studies were carried out on sediment core PM9499 from the submerged river Anabar-Khatanga valley in the western Laptev Sea which covers the time interval since 10 6 ka BP The determined pollen taxa can be grouped into several, ecologically significant associations, which today are characteristic of Arctic Desert, Arctic Tundra, Typical Tundra and Forest Tundra On the basis of local pollen assemblage zones, the record was subdivided into four intervals I (>10 6 ka BP)- apperance of xeric *Artemisia* indicating reduced humidity The presence of wood remains during this time (Bauch et al , 1999) may indicate the near-coastal development of arboreal vegetation, II (10 3-9 6 ka BP) - development of shrub birch vegetation and increased abundance of *Alnaster* pollen indicates warming as well as northward migration of the arboreal vegetation, III (8 5-6 1 ka BP) - a continuous temperature fall and reduction in humidity began, IV (1 7 ka BP-until today) - both the climate and vegetation closely reflect modern conditions

The composition of pollen and spores was also determined in core PM9462 from the submerged valley of the Lena/Yana rivers in the eastern Laptev Sea This core was obtained from 27 m water depth and recovered 467 cm of dark gray silty clay According to radiocarbon data, sediments accumulated during the past 8 5 ka BP The entire time interval can be divided into three local pollen assemblage zones Zone I (8 5 to 6 3 ka BP) - cold and wet conditions dominated by sedge associations, Zone II (6 2-4 8 ka BP) - increased proportion of arboreal pollen *Pinus pumila*, indicating warming, Zone III (4 7 ka BP to present) - development of a typical tundra vegetation Since 1 7 ka BP, temperature has decreased This interpretation is based on the decline in arboreal pollen and the correponding increase in tundra herbs and mosses

Both palynological records indicate some cooling between 8 5 to 6 3 ka BP and cold conditions on the adjacent land after 1 7 ka BP Pollen data from the two cores also indicate that the warmest conditions occurred in the Boreal (10 6-9 6 ka BP) and in the Atlantic periods (6 2-4 8 ka BP) This interpretation confirms interpretations based on terrestrial data showing that during the Early Holocene the climate in the high Arctic was relatively warm Thus, the terrestrially-derived pollen and spores contained in the shelf sediments provide an insight into the vegetational history of the adjacent Siberian hinterland Because most vegetation types and their representative plants are related to distinct climatic conditions, the observed Holocene changes probably reflect geographical shifts in vegetation zones

HIGH-RESOLUTION SEISMIC AND SEDIMENT ECHOSOUNDING INVESTIGATIONS OF SUBMARINE PERMAFROST ON THE LAPTEV SEA SHELF

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High resolution seismic (GI-gun) and sediment echosounding (PARASOUND) profiles were recorded during the Laptev Sea expedition TRANSDRIFT V The aim was to map and characterize the lateral distribution and subbottom depth of the permafrost top The

permafrost was formed during glacial times when the shelf was exposed to very cold air temperatures PARASOUND profiles characterize two different types of facies (i) up to 12 m thick unconsolidated muds overlaying strong distinct or diffuse reflectors and (ii) strong hummocky-shaped reflectors at the sediment surface laterally alternating with small sediment filled pockets For the entire upper 400 m of the Laptev shelf, most seismic profiles are dominated by strong reverberations which are bottom parallel or diffuse Reverberation patterns often coincide laterally with facies (i) and (ii) above It is suggested that most strong PARASOUND reflectors are not related to stratigraphy and may thus indicate the top of frozen ground Reverberations may then be "peg-leg" types of multiples created between the top of the permafrost and the sea floor However, velocity analysis reveals that 3 km/s, commonly observed in solid permafrost, are registered only in a depth below about 70 m subbottom, whereas the velocity increase at the bottom of unconsolidated mud is only from about 1 5 to 1 8 km/s Thus, in places the top 70 m may not or only partly be frozen The formation of reverberations is therefore more complex and probably related to various acoustic effects in the transition from unfrozen to frozen strata within the top 70 m of the shelf sediments

BALANCE MODEL OF HYDROCHEMICAL REGIME OF THE LAPTEV SEA

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The Laptev Sea is a unique environmental complex The severe climatic conditions of the sea determine the vulnerability of marine ecological systems and their restoration period in case of some damage The problems of environmental protection demand constant control For the correct organization of ecological control it is necessary to know the hydrochemical structure of the sea, the fluxes of biota and carbon, their seasonal and inter-annual variability

The study of the spatial and temporal variability of the main hydrochemical indices dissolved oxygen and mineral forms of biota (phosphates, nitrates, and silicates) become especially actual in the process of the completion of our knowledge of the ecological system of the Laptev Sea, as these indices determine productivity

A box model of the hydrochemical regime of the Laptev Sea has been realized Recommendations of LOIKS were taken as the model basis Box sizes were 15x15 nautical miles River runoff was accounted for for the following rivers Lena, Yana, Khatanga, Olenek, and Anabar, and it varied seasonally The model has been adapted for the account of ice conditions

Calculations were carried out in index form in the center of each box, fluxes were given at the box boundaries The flux from the Arctic Ocean was assumed as being constant with a constant content of hydrochemical characteristics Horizontal and vertical diffusion was also taken into account

The steady-state situation of salinity and biota distribution was calculated iteratively The calculations were further carried out using a time step of one day

The obtained results described adequately the mean surface distribution of the hydrochemical characteristics, their spatial variability, seasonal and annual course

BIOCHEMICAL OXYGEN DEMAND IN THE LAPTEV SEA

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The Laptev Sea is subject to river runoff influence, and a large amount of organic matter is transported by it This organic matter is also produced in the sea itself One of the indirect ways to estimate this amount of organic matter is based on the measurement of the biochemical intake of oxygen

The biochemical oxygen demand (BOD) is an important index of ecological environmental conditions The oxygen that comes into water by gas exchange with the atmosphere and the photosynthesis process is spent for the oxidation of the organic matter Therefore, we can estimate the stability and capability of the organic matter of mineralization by the estimation of expended oxygen

The BOD was determined during the last two years in the framework of the Russian-German project "Laptev Sea System 2000" for the periods of one day, five and ten days. In the summer of 1998, samplings were made for BOD determination for a year.

The obtained data allow us to distinguish the regions in the Laptev Sea with different BOD In the summer of 1998, maximum BOD values (0 82 ml/l) in the surface structure were observed in the zone of river runoff influence, and minimum ones (0 05 ml/l) were observed in the northwestern part of the sea In the intermediate and near-bottom structural zones, maximum BOD values (1 52 ml/l) were registered in the western part of the sea, and the minimum ones (0 03 ml/l) in the region of the Lena delta

In the regions of the river runoff influence, BOD values are greater in winter than in summer Maximum BOD values (1 47 ml/l) were observed in the surface structural zone, and minimum ones (0 05 ml/l) were observed in the near-bottom structure On the whole, a tendency is traced for the winter period of oxygen intake increase towards the northwest It should also be mentioned that though the winter BOD values were greater than those in summer, the winter BOD values in the near-bottom structural zone were somewhat less than the summer values

The annual BOD in the Laptev Sea in the surface structural zone varied in the limits from 1 11 to 5 33 ml/l Maximum values were observed in the region of the Trofimovsky channel, and minimum ones in the zone of Arctic Basin influence

The obtained data have been used for the estimation of organic matter fluxes in the balance model of hydrochemical conditions in the Laptev Sea

FEATURES OF FORMATION AND LONG-TERM VARIABILITY OF THERMOHALINE STRUCTURE AND OCEAN CIRCULATION OVER THE SIBERIAN CONTINENTAL SLOPE

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The continental slope, with sea depths from 200 to 2000 m, occupies 4 34 mln km^2 accounting for 29 4 % of the total area of the Arctic The high depth gradients exert a significant influence on the barotropic ocean circulation and ice drift over the continental slope The intense movement of ice and water provides the prerequisite for the formation of numerous cracks, fractures, and pressure ridges in this region The presence of ice-free areas and areas of thin ice in the winter period creates continual convective processes

The continental slope is a zone where there is a complex interaction of the water masses of marginal shelf seas, the water masses of the Arctic Basin, and the waters of non-Arctic origin (the Atlantic and Pacific waters) The appearance of stable and unstable baroclinic structures is a consequence of this interaction It is the opinion of a number of authors that the convection in autumn-winter can reach the Atlantic water layer and be one of the main

mechanisms of the heat transfer to the surface especially in the region of the continental slope and deep-water troughs

Two isolated water masses divided by the vertical convection zone make up a structure typical of the continental slope water area The salinity of the water mass in the convection zone is 32 5-33 0 psu, which is 3-4 psu higher than in the shelf and Arctic surface waters Narrow vertical fronts exist at the boundaries of the convection zones The vertical convection almost completely destroys the halocline and reaches depths of 150-200 m, contributing partially to the release from the Atlantic waters The intensive convection in the region of the continental slope causes a significant reorganisation of the thermohaline ocean circulation The sea level and thermohaline circulation in the Arctic Ocean in the convection developed in the winter of 1979 have been obtained using a numerical diagnostic model The presence of cyclonic eddy formations over the continental slope is a typical feature of the ocean circulation in conditions of intensive convection The largest of these formations with diameters from 150 to 450 km are observed over the continental slope of the Kara and Laptev seas Upwelling in cyclonic eddies can also be an important mechanism of the heat transfer from the Atlantic waters to the surface.

Small scale processes such as internal waves are the third important mechanism of heat transfer and the formation of the thermohaline structure of the waters over the continental slope Internal wave values can be as high as several tens of meters and vertical heat flux is in the range 40-60 W m-2 The intensity of the ocean dynamics over the continental slope is determined by hydrological conditions of the Arctic Ocean such as atmospheric circulation, air temperature, ice conditions, river runoff, and advection of the warm Atlantic and Pacific waters Small, long-term variations of these processes in certain combinations can result in critical values of the parameters of the winter convection and internal wave movements and can significantly affect the thermohaline circulation over the continental slope Climatic signals can be, therefore, amplified in the region of the continental slope

In order to verify this hypothesis, we have calculated the mean magnitudes of the annual temperature and salinity cycles (*Aannual*) and the mean magnitudes of temperature and salinity variations in the course of four decades (50s - 80s) (*Adecade*) for the standard observation depths of the Arctic Ocean using the data of the Joint US-Russian Atlas of the Arctic Ocean The Cl value (ratio of these magnitudes calculated using the formula Cl = *Adecade*A-1annual*) can be used as a measure of amplification of the climatic signal The calculations indicated that the regions with maximum Cl values were located in the layer of 200-300 m, at the depth of the Atlantic water The horizontal Cl distribution illustrates that the maximum Cl values are predominantly located in the continental slope domain and over the Mendeleyev and Lomonosov ridges

Therefore, we intend to use observational data for different years collected at the continental slope in order to reveal the trends of the climatic variability of the thermohaline structure The analysis of variability of thermohaline structure in the region of the continental slope of the Laptev and East-Siberian seas indicates an increase in the temperature of the Atlantic waters from the end of the 70s

GEOMORPHOLOGICAL STRUCTURE OF THE WESTERN SECTOR OF THE LENA RIVER DELTA

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During the 1998-1999 field studies in the Lena river delta, new data specifying the existing understanding of the geomorphological structure and the history of the evolution of the western delta sector were obtained

Two flood plains and three surfaces above the flood plain of different ages were revealed and traced within the study area that is restricted in the east by the Bolshaya Tumatskaya Channel and in the south by the Olenekskaya Channel For each of the levels identified, typical sections of Quaternary sediments were investigated with the determination of the absolute age and a typical complex of cryogenic and bed relief features was revealed One of

the distinguishing characteristics of the terrace surfaces is a different lake ratio. Lakes are also characterized by different morphological indicators of the structure of depressions, genesis and age The following levels were defined

- Low flood plain and a complex of modern bed features (with 1 to 3 m absolute heights) of current age Elongated mortlakes with meandering coastline are widespread The cryogenesis processes are manifested in the presence of individual frost cracks, the polygonal character is not pronounced
- High flood plain (with absolute heights of 4 to 8 m) of the Late Holocene age Datings of 1320±80 (LU-4199) and 2690±100 (LU-4193) were obtained The development of mort and thermokarst lakes with a rounded shape in the plan is typical, the latter being formed as a result of sediments saturated through the melting of ice and refrozen ice veins The AMS-^{14}C dating of bottom sediments of one of the thermokarst lakes is 890±25 Polygonal and polygonal-bar microrelief is developed on the high flood plain surface
- The first terrace above the flood plain (with absolute heights of 9 to 12 m) is of the Early-Middle Holocene age Datings of 6430±120 (LU-4198) and 8570±160 (LU-4191) were obtained Thermokarst lakes predominate Mortlakes are less developed being characterized by a significant reworking of the coastline The dating of one of the lakes is 2575±45 Polygonal and polygonal-bar microrelief is developed Numerous bulgunyakhi are confined to the surface of the first surface above the floodplain
- The second terrace above the flood plain (with absolute heights of 13 to 29 m) is of the Late Pleistocene-Early Holocene age It is characterized by a high lake ratio This indicator on Arga-Muora-Sise Island comprises 40% The genesis of lake depressions of this terrace level remains problematic The AMS-^{14}C datings of bottom sediments of Lake Nikolay-Kyuele are 1540±45 and 3110 ±30 The polygonal character of microrelief is weakly pronounced Thermoerosion ravines located along the refrozen ice veins are widespread
- The third terrace above the flood plain (with absolute heights of 30 to 60 m) is of the Late Pleistocene age The development of thermokarst lakes confined often to swampy bottoms of alassy is typical Bulgunyakhi are observed within the alassy depressions The terrace surface is dissected by thermoerosion ravines Widespread baidzherakhi are typical of the terrace slopes The terrace microrelief is represented by bar polygons and polygons without bars of tetragonal and hexagonal shape

Based on field observations and the interpretation of aerial photography, geomorphological maps with scales of 1 200 000 were compiled for the key segments of the western delta area The cartographic criteria for delineating different terrace levels were the elevation in the relief, sediment composition, character, size, and preservation of bed, and cryogenic relief features, lake ratio and degree of erosion dissection

HEAVY MINERALS IN THE LAPTEV SEA FROM HOLOCENE TO PRESENT

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The distribution of heavy minerals in surface sediments allows a subdivision of the Laptev Sea into three different provinces The western Laptev Sea is dominated by a local garnet enrichment and a high concentration of pyroxene The central and the eastern parts of the Laptev Sea are characterized by higher amphiboles concerntrations, whereas the minerals of mica, rock fragments, and opaque minerals determine the spectrum of heavy minerals in the southeastern Laptev Sea These distribution patterns are mainly influenced by the fluvial input of float debris from the Siberian hinterland Coastal erosion and the processes of sediment redeposition are to be considered

The composition of heavy minerals in sea-ice sediments generally reflect their assemblages in the areas of ice formation A slight shift in the spectrum of heavy minerals in favour of relatively light and fine-grained allows conclusions on the prevailing incorporation mechanism during freeze-up

Heavy mineral and sedimentological analyses, carried out on four sediment cores from the eastern and western Laptev Sea, testify the changing sedimentary conditions due to the slight changes of climatic conditions after the LGC The large amounts of sand and terrigenous plant debris in the lowermost core-section of the Khatanga and Yana valleys, as well as the composition of heavy minerals, which corresponds to the recent Khatanga and Lena sediments, prove the activity of these rivers before the beginning of transgression on the shelf around 10 000 y b p The increasing amounts of garnet and opaque minerals in the western Laptev Sea show the increasing drainage of the Anabar-shield The depocenters of the Khatanga Valley shifted landward due to the rising sea-level High bulk sediment accumulation rates in the northeastern Laptev Sea point to the erosive character of transgression After reaching the recent sea-level around 6 000 y b p , the sedimentation in the Laptev Sea is determined by fluvial input of sediments, coastal erosion, and the prevailing ice conditions Large amounts of mica in the sediments of the eastern Laptev Sea around 5 000 y b p represent an intensive short-term influence of the Yana river Locally restricted enrichments of carbonate near the New Siberian Islands confirm the still remaining influence of the coastal erosion on the sediment budget of the Laptev Sea

OXYGEN CONSUMPTION RATES IN LATE SUMMER OF SELECTED CALANOID COPEPODS FROM THE LAPTEV SEA

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Respiratory rates as an indication for metabolic activity are an important factor to comprehend the significance of zooplankton species for the carbon and energy flow in a marine ecosystem Because respiration is influenced by many factors and also undergoes seasonal variations, these kinds of examinations show a small, but still important part of the whole ecosystem and allow an estimation of the current status of copepod activity in the sample area

The shipboard experiments were conducted during the TRANSDRIFT VII expedition to the Laptev Sea (RV "Yakov Smirnitskiy", 17 8 -16 9 99) on seven stations, where plankton was caught with a bongo net (335 mm mesh size) and a hand net (100 mm mesh size) The work focused mainly on the zooplankton groups *Pseudocalanus major/acuspes, Calanus finmarchicus/glacialis*, and the species *Limnocalanus macrurus* and *Drepanopus bungei* The oxygen consumption was determined using the Winkler method after incubating the copepods in airtight bottles for several hours At three stations the oxygen concentrations could additionally be measured by using a microoptode

The highest oxygen consumption rates were found for *Calanus finmarchicus/glacialis* with rates between 0 474 - 0 061 ml O_2/copepod/h in the northern part of the Laptev Sea and 0 434 - 0 026 ml O_2/copepod/h in the vicinity of Yana river The smaller copepod *Pseudocalanus sp* had an average respiration rate of 0 041 - 0 002 ml O_2/copepod/h Just one station in the southwest near Tiksi showed significantly higher values

A precise estimation about the status of activity is difficult due to missing relative values of this area in other seasons Therefore the data will be compared with values measured in other regions

It seems that *Pseudocalanus* is still very active, but not on the highest possible metabolic level of this species Similar results were reflected for *Calanus sp* Their oxygen consumption rates in the Laptev Sea strongly exceeded the values measured during a diapause in other *Calanus* populations, but they were still slightly lower than the maximum rates of *Calanus glacialis* in preceding studies in arctic regions Summing up it may be said that in late summer, the copepods of the Laptev Sea were still in a status of high to medium metabolic activity

ON THE DYNAMICS OF THE CARBONATE SYSTEM IN THE LENA RIVER - LAPTEV SEA SYSTEM

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It is known that the interhemispheric gradient of atmospheric CO_2 was ~ 1 0 matm in the 1960's and is ~ 3 0 matm now, maximal values correspond to the Northern Hemisphere This change in the interhemispheric gradient might be determined by an increase of the Arctic/Subarctic natural source of CO_2 Based on recent data, we can consider the northern soil as a main regional contributor to the budget of atmospheric CO_2 To evaluate the role of aquatic northern ecosystems as a possible sink or source of this greenhouse gas for the atmosphere, we have established a study of the CO_2 system in the Lena river - Laptev Sea

During the years 1994-1999, 8 riverine and marine expeditions were made TCO_2 was determined on board by a stripping technique with conversion of CO_2 in CH_4 form and FID gas chromatographic detection, pH (NBS) was measured at 25°C just after sampling The partial pressure of CO_2 was calculated from pH and TCO_2 Our data show that the Lena river is a significant source of carbon in mineral and organic form for the shelf waters We show that the river is a persistent source of CO_2 for the atmosphere (500 to 800 matm) along its course with an increased contribution of up to 1170 matm in the delta The distribution of pCO_2 shows that the aquatory of the Laptev Sea even during/after convection and freeze-up is mainly a sink of atmospheric CO_2 with an undersaturation of up to 40-60% Supersaturation with CO_2 is obtained only in restricted areas near the Lena river delta and in some coastal zones

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NEW SIBERIAN ISLANDS: ENVIRONMENTAL CHANGES AND THE HUMAN OCCUPATION

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The climatic changes which took place in the East Arctic around the Pleistocene/Holocene boundary were rather important for the indigenous subsistence systems and cultural evolution of the region A regressive phase of the Polar Ocean (100-120 meters drop) when the major part of the Arctic shelf zone was drained is supposed to be the main factor effecting the natural development of this area Open tundra-steppe landscapes populated by the animals of a mammoth fauna assemblage was the most distinct feature of the East Arctic natural environment up to the beginning of the Holocene

The initial occupation of this area evidently took place in the Terminal Pleistocene and can be supposedly linked with the migrations of mammoth hunters of the Dyuktai culture whose sites are known at least up to 71° N, at the Berelekh site located nearby the Berelekh "Mammoth Graveyard" The natural environment remained rather stable for a long time This world had been crushed by a global Late Dryas warming The changes had a character of an ecological catastrophe The rise of humidity caused a greater thickness of the snow cover in the winter season and the development of swampy lake landscapes This was critical for the animals of the mammoth fauna complex and for the indigenous culture correspondingly because the subsistence strategy of those was based on mammoth hunting In that way, the terminal Pleistocene occupation in the East Arctic was complicated by a sharp crisis of subsistence economy

Major Holocene paleoenvironmental changes which took place in the region were determined by temperature and humidity trends, the development of thermokarst, and oceanic transgression submerging and eroding gradually the Great Pleistocene Arctic plain Tundra-steppe landscapes were completely replaced by tundra formations Although the Holocene

climate of the area was not stable and some fluctuations are recognized, nothing comparable with the terminal Pleistocene changes was found They all were of minor importance The changes are supposed to be more or less synchronous for the entire area. The most significant among those is the northern shift of tree vegetation which took place in the Boreal Macro-remains of tree plants, aged to 8-9000 yrs ago, were repeatedly found far north from the modern tree line A position of the Boreal treeline corresponds supposedly to the modern shoreline Tree vegetation occupied even southern Arctic islands Such conditions were probably favourable for new migrations to the Polar areas For this time the Zhokhov site is the most important evidence of human habitation in the high Arctic areas

This site, excavated in two field seasons (1989-90), is located on the Zhokhov island beneath 76°N latitude and belongs to the New Siberian island chain, which constitutes the natural boundary between the Laptev and the East Siberian seas Abundant artifacts and fauna remains characterizing an ancient aboriginal culture were discovered The chronology of the site is grounded by results of the radiocarbon dating of charcoals, bone, and wooden pieces Over 20 samples are tested The mid-value is 7800 - 8000 carbon yrs ago

Some cooling was found to take place in the end of the Atlantic and sub-Boreal stages The natural environment of the area became close to the modern one in the sub-Atlantic There is no evidence of human occupation for that time but it is possible to expect that it was populated or repeatedly visited by continental hunters up to 3500 yrs ago

OXYGEN AND NUTRIENTS IN THE WATER MASSES OF THE LAPTEV SEA

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Water masses are the basic elements of the water column They are recognized by different temperature and chemical and biological properties as well as dissolved oxygen and nutrients New data obtained during the Russian-German expeditions TRANSDRIFT are used to develop the theory of the water mass formation in the shallow Arctic seas and as an example in the Laptev Sea Chemical tracers proved to be very useful for the study of the mosaic and flaky structure of the seas The schemes showing the location of the main types of water masses in the structural zones of the Laptev Sea in winter and in summer are suggested The conclusions are

- there is a great limited number of water masses in the multifactoral system of the Laptev Sea, which can be separated into several types according to their positions in the structural zones and according to the places and time of water mass formation,
- a total number of water masses depends on the scale and on the objectives of an investigation,
- the water masses in shallow regions of the Laptev Sea are characterized by small volumes and a short time of their "life",
- water masses with different physical, chemical, and biological properties are formed in the same regions of the sea during different seasons

The characteristic values of dissolved oxygen and nutrients corresponding to the main types of the water masses of the Laptev Sea are presented

LATE HOLOCENE VARIATIONS IN THE CONDITIONS OF FLUVIAL RUNOFF AND SEA-ICE COVER IN THE LAPTEV SEA

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One of the major open questions regarding the paleoenvironmental evolution of the Arctic during the Holocene is the temporal variability of river-runoff and sea-ice regime The Laptev Sea situated in the central part of the Eurasian Arctic shelf plays a special role for the formation of sea-ice and hydrological conditions in the Arctic Ocean due to the strong freshwater input during summer and the creation of extensive flaw leads during winter Calculations and observations carried out in the Laptev Sea during the last years revealed the leading role of river runoff in the processes of ice formation and interannual variations of the flaw lead location It was found that the formation of the fast ice edge greatly depends on processes related to the river runoff (Dmitrenko et al , 1998) The present study gives one of the first detailed accounts on the short-time changes of river runoff and sea-ice regime in the vicinity of the Lena delta using radiocarbon-dated sediment cores in combination with investigations of the diatom composition

The Cores PM9482-2 and PS092-12 used in the present study were obtained during the TRANSDRIFT II expedition and ARK-XIV/1b TRANSDRIFT V (Kassens and Dmitrenko, 1995, Kassens et al , in prep) from the southern part of the Laptev Sea close to the edge of the mean interannual position of the flaw lead This region today is influenced by the intensive Lena river runoff and, therefore, represents a sensitive and important area for understanding the interaction between marine and fresh waters The distribution patterns of sea-ice diatoms observed in the Laptev Sea shelf surface sediments in relation to oceanological conditions revealed that the relative abundance (10%) of sea-ice species coincides with the mean interannual location of the flaw lead, thus giving evidence for the geographical location of the flaw lead in the Laptev Sea (Polyakova et al , in press)

The distribution of diatoms (total abundance per gram of dry sediment, and relative abundance of ecological groups - freshwater diatoms, marine and sea-ice diatoms) in the studied sediment cores reveal variations in the sea-ice regime and hydrological conditions during the last 4 7 thousand years The most favorable hydrobiological conditions for the diatom development characterized by a sharp increase in the diatom number in sediments and an increase in the relative abundance of marine planktonic species corresponds to the time interval 2 9-4 34 ka It correlates well with the "marine Holocene optimum" (time interval 2 5-5 5 ka), which has been previously established in the Eurasian Eastern Arctic seas (Polyakova, 1997, 1999) The data further allow the speculation that the position of the Laptev Sea flaw lead must have shifted away from its mean modern location during the past 4 7 ka These geographical shifts were probably induced by variations in the Lena river runoff

GENESIS OF WATERS AND ICE IN FLAW POLYNYAS OF THE LAPTEV SEA AND ITS ROLE IN CLIMATE CHANGE IN THE NORTH POLAR AREA

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A scheme of the quasi stationary flaw polynyas of the Laptev Sea is presented Based on the analysis of satellite ice maps, a time series of 10-day data on the area of 5 flaw polynyas of the Laptev sea area for the period of 1978 - 1994 was constructed For each flaw polynya, calculations of the sea/air energy exchange parameters were performed using the method developed at the AARI (Ivanov, Makshtas, 1989) The results of the analysis of the temporal variability of the given values are presented. The links between the variability of the atmospheric processes in the northern polar area and the sea/air energy exchange in the

area of flaw polynyas were investigated Using the model of Martin and Cavalieri [Martin, Cavalieri, 1989, 1994], calculations of the volumes of new ice and water produced in the flaw polynyas of the Laptev Sea were performed The comparison with previous research was carried out The analysis of the temporal variability of the obtained series testifies to a significant role of flaw polynyas of the Laptev Sea in the climate change in the northern polar area The relation between the processes of the genesis of new ice and waters and the formation of the so-called "Great Salinity anomalies" in particular are shown

LANDSCAPE SUBDIVISION OF EAST TAIMYR (VERCHNAJA TAIMYRA- PRONCZISHEVA BAY SUB-LONGITUDE TRANSECT)

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The transition zone (macroecoton) between the Byrranga mountains and the North Siberian lowland is one of the least investigated regions of the Arctic, the boundary between subzones of the Arctic and typical tundras here passes too The map in a 1 1000000 scale is made thanks to field observations and remote sensing materials It surrounds the transect, extending from southwest to northeast more than 600 km The territory includes 3 tundra sites of the reserve "Taimyrsky" - main, experimental polygon "Bikada", and Arctic filial The lake "Taimyr" is also located here The main material for subdivision was given by observations on 10 key plots The large-scale (1 50000-1 100000) complex maps with the matrix legend and with detailed explanatory text are made on the majority plots At the same time, the author selects key plots for future operations on the basis of adduced subdivision, as some species of landscape are not yet covered by detailed observations

The available information about the nature of the central and eastern part of the Byrranga mountains is rather fragmentary Many schemes of natural subdivision did not take into account at all these mountains as an independent mountain unit The quaternary history of the territory is written almost extremely with glaciatiolistic positions The results of the last researches are not always stacked in this concept So, on all the southern macroslope of the Byrranga mountains, the precisely expressed fragments of ancient marine terraces are detected which have levels of 50, 100, and 200 m above sea level in the western part, and 80, 120, and 250 m - in the east The pebble-sandy deposits, composing them, essentially differ from the glacial by a pH of more than 7 and by specific deposit material The presence of these terraces is a criterion of a selection of ecotonal foothill glacial-marine landscape Besides, on the slopes of some moraine ridges, there are outputs of salted clays, connected usually with a level of 100 m above sea level Thus, the role of the marine transgressions in the creation of a relief of East Taimyr was rather significant The cover glaciations, which formed the moraine ridges of the North Siberian lowland, must probably be attributed to an earlier time than the Sartan Our subdivision is executed in view of these assumptions The subdivisions are executed on the typological basis with a selection of 6 hierarchical levels - type, subtype, class, subclass, genera and species of a landscape, and for some species (only in mountains and foothills) - subspecies of a landscape The main unit shown on a map is the landscape species In total, on the mapped territory, there are 36 species and subspecies of landscapes, which relate to one type (North Siberian-tundra), two subtypes (arctic-tundra and typical-tundra), and two classes (mountain and plain)

THE FLORISTIC RELICTS IN BYRRANGA MOUNTAINS, TAIMYR PENINSULA

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The recent vascular flora of the Byrranga mountains was formed in a long period by autogenous elements as well as by the migration of more southern and eastern plant species They penetrated to the north during the periods of climate optimums, marine transgressions, and retrogressions in the Holocene According to the results of botanical research in 1991-98 in the central and eastern parts of the mountains, the vascular flora of this province account for 82% of all the eastern Taimyr flora At the same time, hypoarctic and boreal species (32% together) contribute an essential part in comparison with cryophytes prevailing, which is usual for arctic floras It is higher than that in a more southern plane of typical tundra The part of sub-endemic East-Siberian species is essentially 22% The originality of flora is emphasized by the presence of specific groups of species 1) the isolated mountain populations of species, having their nearest localities on the Putorana mountain and the Lena river's lower reaches or, moreover, more east, 2) the isolated populations of southern species, having their nearest localities in the southern tundra and forest-tundra Both of them are overgrown with relict plant communities of mountains and foot-hills with tall willows (formed by Salix alaxensis) , alpine stepped meadows, Alnaster fruticosus-bush and inter-mountain dwarf-birch bogs The first point to the ancient floristic connections of Northeast Siberian mountain systems, connections carried out via the exposed coastal shelf during the Beringian marine retrogression The second point to the existence of a floristic refugium in the Byrranga mountains during the last glaciations They are likely to be relicts of a Holocene climate optimum when forest-tundra vegetation in foot-hills was being formed not only due to species moving from the south within the northern forest border, but due to moving out from mountain refugia, where the southern species was conserved since the Karginsky climate optimum during the Sartansky glaciation Thus, two seats of southern species distribution on the plane existed in that time in southern woodlands and in northern mountain refugia The floristic and phytocoenotic similarity of the Fadyukuda river west basin and Bikada river east basin leads to an idea about the existence of residual lake basins after the Karginsky transgression reducing, this fact is emphasized by the presence of marine terrace fragments, formed by carbonate material, in both river basins

DISTRIBUTION AND ABUNDANCE OF BIRDS AND MARINE MAMMALS IN THE LAPTEV SEA

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Earlier the investigations of the character of summer distribution and abundance of birds and marine mammals in the Laptev Sea were not conducted in contrast to other Arctic seas Our observations were carried out during the period of 28 July to 18 August 1998 from the RV "Polarstern" during both its cruising and stops The total distance of counting route was 1104 km Basic observations were carried out in the eastern Laptev Sea region between 73°30'-78°04' N and 128°14'-133°49' E In the western Laptev Sea region, observations were restricted to the area between 75°30'-77°16' N and 116°03'-123°55' E A total of 1842 birds of 15 species and 34 mammals of 4 species were registered The average numbers in the Laptev Sea made up 9 4 ind/10km^2 for birds and 0 14 ind/10km^2 for marine mammals

Among the birds, *Rissa tridaktyla* (5,5 ind/10km^2) and *Stercorarius* pomarinus (2,3 ind/10km^2) prevailed Abundance of *Somateria spectabilis, Phalaropus fulicarius, Larus argentatus, L hyperboreus, Stercorarius parasiticus, S longicaudus, Uria lomvia* made up 0,1-0,4 ind/10km^2 *Xema sabini, Pagophila eburnea, Cepphus grylle* (0,02-0,04 ind/10km^2)

were rare We observed *Rhodostethia rosea* only during the ship stops, and *Clangula hyemalis* and *Fulmarus glacialis* were recorded beyond the limits of the surveys The characteristic peculiarity of bird distribution is closely related to the areas with floating ice where the abundance of birds (14 3 ind/10km^2) is more than in 10 times in contrast to the open water regions (1 1 ind/10km^2) There were no *X sabini, Rh rosea, P eburnea, S longicaudus, C grylle* in the open water regions

Erignathus barbatus (0 06 ind/10km^2) and *Odobenus rosmarus* (0 04 ind/10km^2) were of the greatest abundance among marine mammals, and *Ursus maritimus* and *Pusa hispida* were rare (0 02 ind/km^2) *U maritimus* and *O rosmarus* were surveyed only on the ices *P hispida* was equally often observed both in the open water regions and on the ices

MONITORING FOR WATERFOWL IN THE LENA DELTA

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The Lena delta is a key site for waterfowl in the Arctic The abundance of many breeding populations of birds exceeds 1 % of the overall population estimate A constant monitoring for the population status is also necessary because in high latitudes, the birds very sensitively react to changes of the factors of the environment and frequently they are indicators of these changes Our researches for the population status of the birds in the Lena delta under the program "Laptev Sea System 2000" in 1998-1999 have continued the works, begun in 1994 under the program of the Arctic Expedition of Sakha Republic (Yakutia) The account method of birds on the channels from a motor boat was basic Despite some lacks, this method allows to survey large areas of waterlands in a short period of time, to find sites of seasonal bird concentrations, to estimate their total abundance, the character of distribution, breeding success in a concrete year

Swans 2 species *Cygnus cygnus* is rare in the southern part of the delta *Cygnus bewickii* is abundant in all parts Total abundance is about 6,000 The basic breeding area is between the Arynskaya and the Trofimovskaya channels Nonbreeders are more common in the northern and northeastern parts of the delta The maximum number of birds on the channels is 4 6 ind /10 km 10-25 % of the population take part in the breeding Breeding success was low in 1996 and 1998 and high in 1994, 1995 and 1999 The mean size of the brood was 2 5-3 8 in various years

Geese 6 species Only 3 are common On the breeding ground, *Anser fabalis* is abundant in the southern half of the delta Total abundance is no more than 10,000 The maximal number on the channels in the brood period is 12 3 ind /10 km 24 % of the population took part in the breeding in 1994 *Anser albifrons* is abundant in the northern half of the delta The total number is about 15,000 The maximum number on the channels in the brood period is 26 5 ind /10 km 10-26% of population take part in breeding The breeding success of these species was high in 1994, 1995, and 1999 *Branta bernicla* is abundant on the breeding ground in the seaside areas of the delta *Branta bernicla* are mainly observed in the interior parts of the delta during spring migration Total abundance is about 5,000 Breeding was successful in 1995, 1996, and 1999

Ducks 17 Species 8 species breed in the delta *Anas crecca, Aythya fuligula, Melanitta nigra, Mergus serrator* are rare *Anas acuta, Clangula hyemalis, Somateria spectabilis, Polysticta stelleri* are abundant During nesting period they are rare on the channels of the delta Numbers considerably increase during migrations The total abundance of ducks is about 200 000 in the delta (Blokhin, 1990)

CRYOSTATIC PRESSURE DEVELOPMENT IN FREEZING AND THAWING SOILS

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In order to get information about the pressure development in freezing soil monoliths, laboratory tests are carried out at the Soil Department of the University of Kiel (Germany) Soil cores (18 cm high and 6 cm in diameter) were taken during the arctic summer 1998 in the Lena delta (Siberia) This expedition is part of the Russian-German cooperation "Laptev Sea System 2000" Cryostatic pressures arise as soon as the phase change of soil water into soil ice begins The freezing occurs downward from the ground surface and, in permafrost-affected soils, upwards from the frost table The part of the soil remaining unfrozen for the longest time can be subjected to overconsolidation in dependence of the freezing gradient and water content Water phase transitions occurring in freezing and thawing soils are the main factors influencing the force field within the soil Variations of temperatures below 0°C do not only affect the amount of ice, but also its state of stress and therefore the mechanical properties of the soil

The objectives of the studies are the determination of cryostatic pressures in different soil substrates (structured and unstructured) and soil water contents and their influence on the pore size distribution, interest is taken in cyclic freezing and thawing

For this purpose, soil samples are kept in a plastic core with a low heat conductivity and thermal expansion coefficient A constructed cooling system enables mono- and bi-directional freezing, down to minus 20°C The thermal gradients can be varied Thermistorpearls (accuracy 0 2°C, 2 mm in diameter) and TDR probes (Time Domain Reflectometry, Easy Test Poland), installed in different depths record the penetrating frost fronts and the migrations of soil water A stress transducer (DAK, Watzau, Germany) fixed to the plastic corewall, measures the arising and breaking up of the pressure All data are recorded by a Datalogger (Delta-T) First results show that seasonal freezing can lead to an expansion and shrinkage of the soil The recorded pressure enables us to predict arising pressures in dependence on the soil water/ice content and its changes during the freezing and thawing processes Changes in the pore size distribution and its continuity have great effects on the output of soil gases (e g , carbon dioxide, methane) to the atmosphere

MODERN SEA-ICE TRANSPORT OF RIVERINE SEDIMENTS FROM THE LAPTEV SEA TO THE FRAM STRAIT BASED ON CLAY MINERAL STUDIES

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In order to identify the pathways and processes of modern sediment transport from the Siberian hinterland to the Laptev Sea and further to the Arctic Ocean, clay mineral analyses were performed on riverine suspended particulate material (SPM), surface sediments of the Laptev Sea shelf, and sea-ice sediments (SIS) The material collected during 7 expeditions from 1992 to 1996 was included in this study Clay mineral assemblages are used to decipher the distribution of riverine sediments within the Laptev Sea shelf region, the processes of sediment entrainment into newly forming ice, and the transport of SIS from the Laptev Sea towards the ablation areas

The clay mineral signature of Laptev Sea shelf sediments is mainly controlled by the input of riverine SPM supplied by the Lena, Yana, and Khatanga rivers While the eastern Laptev Sea is dominated by illite (mean 66 % of clay minerals), imported through the Lena

and Yana rivers, the western shelf region is characterized by higher smectite concentrations (up to 65 %), originating from the Siberian Flood Basalts in the Khatanga basin The ratio (Smectite+Kaolinite) vs (Illite+Chlorite) can be applied to distinguish 5 clay mineral provinces within the Laptev Sea shelf

1 - northwestern Laptev Sea shelf (influenced by the Kara Sea),
2 - southwestern shelf drained by Anabar and Khatanga rivers,
3 - central Laptev Sea (hydrographic frontier zone),
4 - eastern shelf between Lena delta and Kotelnyy Island,
5 - southeastern shelf drained by Omoloy and Yana rivers

The smectite concentration serves as an indicator for source areas of SIS of the Arctic Ocean. Based on smectite content, a Siberian branch (originating in the western Laptev Sea, eastern Kara Sea) and a Polar Branch (from eastern Laptev Sea) of the Transpolar Drift can clearly be distinguished

AN INTERNATIONAL WORKSHOP ON ARCTIC COASTAL DYNAMICS, MARINE BIOLOGY LABORATORY, WOODS HOLE, MA, 2-4 NOVEMBER 1999

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In this poster, we present a summary of the International Workshop on Arctic Coastal Dynamics, which was held at the Marine Biology Laboratory, Woods Hole, MA, November 2-4, 1999 The scope and major objectives of the workshop were to

1 develop a common classification system for coastal mapping in the Arctic for purposes of estimating the coastline sensitivity to change and erosion potential,
2 identify and describe the techniques presently used for coastal mapping and erosion measurements in the Arctic, and develop a standardized set of tools and techniques, and to
3 develop estimates of erosion rates for representative circum-Arctic coastlines

The main emphasis of the workshop was laid on

- Field techniques for measuring and mapping high latitude coasts,
- Applications of remote sensing to Arctic coastal monitoring and mapping,
- Computer techniques for measurement of coastal retreat,
- Ice content (measurement and mapping),
- Ice processes,
- Shoreface profiles of high latitude coasts,
- Circum-arctic coastal mapping — classification of high latitude coasts

These topics were covered by oral presentations and/or discussed in smaller working groups

THE GENERAL FEATURES OF QUATERNARY DEVELOPMENT OF THE LAPTEV SEA SHELF SEDIMENTS COVER, AS A RESULT OF THE GEOLOGICAL MAPPING OF SHELF AND ADJACENT LAND AREA

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Quaternary sediments of the Laptev Sea shelf and adjacent land were investigated to reconstruct the paleoenvironmental history during the Quaternary period The shallow geology map of the shelves, adjacent to the Severnaya Zemlya, Taimyr, and Novosibirskie Islands (scale 1 1 000 000) (the authors Musatov E E , Rekant P V , Roudoy A S) were created as a result of the complex interpretation of the High Resolution Seismic (HRS) data on the shelf, geological and drilling data which were obtained on the land The general features of the Laptev Sea shelf Quarternary sedimentary cover were determined

1 Two types of the Quaternary section are common for the Laptev Sea shelf

The **Laptev type** itself (in the eastern and in the central parts of the shelf), which include seven sediment units, corresponding to Upper Miocene-Lower Pleistocene, Middle Pleistocene, Kazan (Q_{III}^{1}), Zyryan (Q_{III}^{2}), Kargin(Q_{III}^{3}), Sartan (Q_{III}^{4}), and Holocene intervals

The **Western Laptev type** similar to the Barents-Northern Kara one This type consists of Kazan (Q_{III}^{1}), Zyryan (Muruktin) (Q_{III}^{2}), Kargin(Q_{III}^{3}), Sartan (Q_{III}^{4}), and Holocene units and has a reduced stratigraphic value

2 The Pleistocene transgressive-regressive cycles (established on the adjacent land) influenced the environmental changes on the shelf Despite similar transgressive-regressive cycles for the whole shelf area, these cycle changes formed various types of environments in the western and eastern parts of Laptev Sea shelf So Sartan and Zyryan regressions were the reason of the glacial environments in the western Laptev Sea and non-glacial, but cryogenic ones (development of permafrost) in the eastern Laptev Sea

3 In the eastern Laptev Sea shelf, three regressions, correlated with the Middle Pleistocene, Zyryan, and Sartan epoch, were identified During the Zyryan and Sartan epoch in this region, two levels (generations) of permafrost were formed And so three different generations of the paleoriver channels (Middle Pleistocene, Zyryan, and Sartan respectively), which were authentically traced by HRS data up to the 100-110 isobath had been created The formation of paleoriver channels and permafrost suggests that most of the Laptev Sea shelf area was not covered by large ice sheet not only during the Sartan interval [Kleiber H P et al , 1999], but during the entire Late Pleistocene period

4 The current results show that on the western Laptev Sea shelf, there is recognized the evidence of Late Pleistocene glaciating During the Zyryan period, the glacial sheet covered a large area of the Severnaya Zemlya, Taimyr, and adjacent Kara and Laptev seas shelves This area is marked by acoustically transparent glacial tills, which were identified on HRS profiles However, at the beginning of the Sartan, the glacially covered area was considerably reduced The glacial sheet covered Severnaya Zemlya and the adjacent Kara shelf, thewest of the Vilkitsky Strait and the northernmost part of Taimyr (rivers Shrenk and Nygnyay Taimyra region) In the Holocene the glaciating is concentrated only in the boundary of the archipelago Severnaya Zemlya

GEOMORPHIC EVIDENCE OF RECENT VERTICAL EARTH CRUST MOVEMENTS OF THE LAPTEV SEA MARGIN

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The interpretation of modern topography data (bathimetric map of the scale of 1 1000000), sparker records, seismic acoustic materials, and bottom coring data carried out during the cruises of Russian vessels [Paleogeographic Atlas, 1991, Kim B , Gricurov G , Soloviov V , 1999] and the German icebreaker RV "Polarstern" [Rachor E , ed , 1997,

Kassens H , ed , 1999, Fuetterer D , ed., 1994] provides the evidence of the relative submergence of the Western Laptev Sea Margin in comparison with the relative uplift of its eastern part in the Late Pleistocene and Holocene time This conclusion is confirmed by the following observations

1 The thickness of the Quaternary cover on the Laptev Sea shelf increases from west to east In the western part, the veneer of recent deposits is only a few meters thick It is composed predominantly of silty-clayey sediments from the Late Pleistocene and Holocene periods The bedrock is often exposed there In the eastern part, the whole Quaternary section is composed of more complete sequences up to 50 meters thick Tectonic deformations occuring in the western part of the Margin disappear eastwards from 136°E

2 The shelf break is fixed by a crucial change of the slope steepness at the depth of about 100 meters Another submarine scarp corresponds to the Sartanian (Late Weichselian) shore line In the western part, there is a wave-cut cliff below the modern shelf break, while in the eastern part of the Margin, it is situated above the shelf break The valley heads of major submarine canyons coincide just with this Sartanian shore line In the eastern part of the Laptev Sea Margin headstreams of canyons cut this shore line, while in the western part they do not reach it These observations confirm the evidence of the recent uplift of the shelf break area in the western Laptev Sea Margin and its recent submergence in the eastern part of this transitional zone

3 The change in configuration of the river mouths in the Laptev Sea from the estuaries in the west to the deltas in the east has already been noted by American investigators [Holmes and Creager, 1974]

In order to improve our knowledge of the regional vertical recent tectonic movements of the Laptev Sea Margin, it is necessary to take into account data on the modern tectonic activity in this region. Recent tectonic activity manifests itself in the existence of an extensive belt of modern earthquakes [Avetisov G , 1996] coinciding with the lithospheric plate boundary and dividing the whole continental margin into two areas characterized by the opposing directions of modern vertical earth crust movements near the shelf break

METHANE GENERATION IN TUNDRA CRYOSOLS AT NEAR ZERO TEMPERATURES

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The study of the biogeochemical processes which control the methane emission from tundra cryosols is of great importance in relation to the feedback to climate warming

There is a considerable amount of data on the methane generation and oxidation in an active layer of cryosols during summer but little information on the soil biological processes in autumn and winter In previous studies of tundra cryosols of the Kolyma Lowland, Taimyr Peninsula, and Lena delta, we detected a considerable methane generation in wet soils at the permafrost boundary (+0,5 - 0°C) using ^{14}C-labeled substrates in situ and soil incubations in laboratory In later experiments during the Russian-German expedition in the Lena delta in summer 1999, anaerobic incubations of fresh wet soils on the permafrost boundary were used to confirm noticeable methane generation in situ at near zero positive and negative temperatures

The unfrozen "zero curtain" layer in tundra cryosols persists from the beginning of the freezing in September through October, sometimes to November and probably to December in the forest tundra and northern taiga Wet soils in the process of freezing may contain sufficient liquid water while the diffusive and plant mediated transport of gases through surface frozen soils is limited Reducing conditions in unfrozen layer suppress methane oxidation and favor microbial methane generation and accumulation In spring, methane generation proceeds not only in the thawed surface soils but may awake in the spreading (0°

C) cold soil layer Thus, the methane produced in cryosols in autumn, winter, and spring at near zero temperatures can be a marked proportion of an annual methane budget and a noticeable contribution to CH_4 emission

Climate warming can increase the summer soil thawing depth, the thickness and persistence of the unfrozen soil "zero curtain" layer, methane production and accumulation in autumn and winter, and subsequent spring methane emission

Future studies of this problem should include measurements of methane concentrations and oxygen availability in the unfrozen soil layer, the determination of in situ methane generation and oxidation rates with ^{14}C- labeled substrates during soil freezing and thawing, and the isolation of psychrotrophic methanogenic and methanotrophic bacteria It is also important to continue the measurements of the ion concentrations (nitrate, ammonium, phosphate, bicarbonate, sulfate, acetate, iron, and manganese) in soil pore waters initiated by the AWI Potsdam It was shown that the concentration of these ions in pore waters of the unfrozen soil layer increases in the course of freezing (Overduin, P P , 1997) By this means, the possibility of aerobic and anaerobic methane oxidation and the competition of methanogenic bacteria with the other anaerobic microorganisms (denitrifyers, iron, manganese and sulfate reducers, acetogenes) in these conditions should be clarified

LONG-RANGE SEASONAL AND ANNUAL VARIABILITY OF THE SIBERIAN RIVERINE DISCHARGES (LENA AND OTHERS) AND THEIR CONNECTION WITH THE ARCTIC GENERAL CIRCULATION REGIME

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The change in land hydrology is reflected in the river discharge variability that regulates the global climate because the riverine discharge from Siberia plays a key role in maintaining the stratification of the Arctic Ocean and in controlling the existence of the sea-ice cover and deep water formation in the North Atlantic and the Thermohaline Conveyer System The Lena river is considered as the basic river in our research because the changes in its hydrology play a key role in feeding the Transdrift because of the change in the freshwater input to the Laptev Sea

Based on all available data sets (up to 60 years) for the Ob, Yenisey, and Lena, we have evaluated the long-range seasonal and annual variability in the riverine discharge and its connection with the wind-driven circulation regime in the Arctic We have found a long-range variability in the seasonal values of the winter and summer values of discharges, caused by an atmospheric regime shift at the beginning of the 70s, especially in the cold season. Averaged winter values increased on the Ob 13%, on the Yenisey 45%, on the Lena 25% The multi-year winter discharges show positive trends The mean winter discharge of the great Siberian rivers in the Arctic Ocean increases by the value of ~165 km^3 This growth is connected with a change of meteorological conditions (precipitation, air temperature, unfrozen period, soil temperature) in these riverine basins due to global warming The annual mean discharge increased by 4 5%

The variability of the integrative discharge anomaly in the main Siberian rivers agrees with the two circulation regimes of the wind-driven Arctic Ocean a cyclonic and an anticyclonic It was found that the extreme in the intensity of the An-regime or the Zn-regime and their periodicity agree quite well with positive and negative anomalies in the discharge of the great Siberian rivers (and their total) and their periodicity A positive anomaly in the mean annual river discharge corresponds to an An-regime, and a negative anomaly in river discharge corresponds to a Zn-regime This agreement was found for the time period from the late 1940s until the mid 1970s (until the mid 1980s for the Yenisey) when the frequency of the anomalies in the "zonal" W-type of atmospheric circulation changed from "high" to "low" with a strong negative anomaly in the mid 1970s, while the "eastern meridional" E-type (cumulative curve) of circulation increased drastically in the 1970s-1980s after a climatic shift in the 70s

PERMAFROST DEPOSITS AS ARCHIVES FOR PALEOCLIMATE AND PALEOENVIRONMENT - EXPEDITION TO THE BIG LYAKHOVSKY ISLAND, 1999

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The cliffs of the south coast of the Big Lyakhovsky Island contain deposits of the Lower, Middle, and Upper Quaternary In summer 1999, a group of Russian and German scientists studied 6 km of the coastal outcrops in order to record different parameters for the reconstruction of the paleoclimatic and paleoenvironmental conditions in the Laptev Sea region

The main topics of the field work are
- Geological and cryolithological mapping and facies differentiation of the deposits
- Sampling of frozen sediments and measurement of ice contents
- Characterization of the different types and generations of ice wedges
- Detailed sampling of typical ice wedges for isotope and hydrochemistry analysis
- Sampling of recent waters like rain, surface water, snow patches, ground water
- Measurement of the pH and electrical conductivity of ice and water samples
- Sampling for age determination (conventional radiocarbon dating and AMS, Optical Stimulated Luminescence (OSL), Paleomagnetics, Uran/Thorium-dating)
- Collection of fossil bones
- Screening of sediments for rodents and insect studies
- Sampling for seed analyses (carpological studies)
- Mapping of different types of recent soils in the study area, description of paleosols
- Determination and collection of recent tundra vegetation
- Study of the past and present thermokarst processes
- Sampling for the thermo-physical analysis of permafrost deposits

Eight different geological and cryolithological units could be distinguished

1 Permian basement of quartzitic sandstone, slates, basalt, granites, quartz-pebbles, porphyry

2 Well developed weathering crust

3 Ice rich, coarse clastic series with stones of reworked basement, peat inclusions, peat horizons, and paleosols - provisionally named as Olyor-Suite (QI)

4 Two facies provisionally named as Kutschuguy-Suite (QII) a) Dryer subaerial silty-sandy series with many vertically orientated grass roots, b) subaquatic sediments with molluscs

5 Late Pleistocene ice complex with big ice wedges and many peat inclusions and paleosols in the upper level - (QIII)

6 Holocene subaerial and subaquatic alas deposits in former thermo-denudation depressions (QIV) underlain by talik formations (taberites, ice wedge pseudomorphisms)

7 Holocene deposits of thermo-erosional small bottom valleys (Russian Log) (QIV)

8 Recent fluvial, alluvial, and slope deposits

All these units are characterized by different types of ice wedges, distinguished in size, shape, color, ice structure, and ice crystal size and texture, gas and sediment contents The mammal association consists of woolly mammoth, woolly rhino, horses, reindeer, muskox, bison, bear, hares, lion This expedition to the Big Lyakhovsky Island continues the studies of the permafrost sequences on the Bykovsky Peninsula in order to compare

paleoclimatic and paleoenvironmental archives of two different locations in the Laptev Sea region

PALEOENVIRONMENTAL AND PALEOCLIMATIC RECORDS FROM PERMAFROST DEPOSITS OF THE BYKOVSKY PENINSULA

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Ice-rich permafrost sequences at the Laptev Sea coast were studied by a joint Russian-German group on the Bykovsky Peninsula (southeast of the Lena delta) during the summers of 1998-99 The studied sections present a continuous record of the paleoenvironment in the Laptev Sea region during the last 60 ka The whole succession has been sampled in great detail, and interdisciplinary study of these samples is still in progress

Three different genetic units corresponding to three geomorphologic elements were recognized in the coastal outcrops of the Bykovsky Peninsula The Late Pleistocene ice complex deposits with thick ice wedges build the high Yedoma surface up to 40 m a s l The ice complex is bound laterally by the deposits of Holocene alas depressions of thermo-denudative origin and is covered by the sediments of small thermo-erosional valleys of Holocene age on the top The ice complex consists of an upper level with many peat inclusions and paleocryosols (45 - 12ka) and a lower level with less peat inclusion and weak paleosol formations (60-45 ka)

Different generations of ice wedges were found in these three genetic units They differ each in size, colour, gas content, ice crystal texture It is possible to distinguish the ice samples of Pleistocene, Holocene, and recent ice wedges by means of water isotopes $\partial 18O$ and ∂D and by hydrochemistry (pH, electrical conductivity, anions and cations) (Meyer & Derevyagin, this volume)

More than 600 fossil mammal bones, collected at the Bykovsky Peninsula, build one of the most representative collections in the Eurasian north The sample from the main ice complex exposure (145 specimens) is clearly dominated by woolly mammoth, reindeer, Pleistocene hare, extinct horse and bison were common animals This complex of herbivorous mammals was typical for the Late Pleistocene and inhabited the whole area of the drained Laptev shelf Among 40 radiocarbon dated mammal bones from this collection, 24 dates on mammoth present a unique series, and document the presence of this species from 45 to 14 3 ka

The ecological analysis of 25 fossil insect samples from the ice complex portrays non-analogue insect assemblages of open grassland, typical for the Late Pleistocene Arctic Dominated by the inhabitants of various tundra biotopes, they are marked by a significant participation of steppe and dry grassland species and are notably different from the Holocene and recent assemblages The succession of fossil insect assemblages shows a variation in vegetation and presumably in local climate during the accumulation of the ice complex They range from rather xerophylic assemblages, dominated by steppe and dry tundra species, to warmer and wetter tundra assemblages, with only few steppe elements The studied section represents the most complete succession of insect assemblages, known for the ice complex (Kuzmina et al , this volume)

Similar to the results of the insect species spectrum analysis, the carpological results reflect typical Late Pleistocene biocoenosises The species composition, dominated by typical tundra plants, is supplemented by steppe and mountain steppe elements as well as *Kobresia* and *Orostachys spinosa* Among the recently occurring tundra plants, there predominated mainly pioneer plants, preferring rather well drained habitats Nevertheless, beside the above mentioned steppe species, a mosaic like the distribution of both dry and

wet locations is evidenced by the appearance of submergedly living hydrophyts like *Potamogeton* and *Batrachium* The species' rich flora of the investigated section is promising concerning the reconstruction of Late Pleistocene environmental conditions

A preliminary scenario of the periglacial landscape evolution during the late Quaternary in the study area is suggested, with some paleoenvironmental and paleoclimatic conditions reconstructed for certain time intervals

ENERGY FLOW THROUGH THE MARINE ECOSYSTEM OF THE LAPTEV SEA

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This paper gives an overview of the trophic dynamics of the Laptev Sea ecosystem as far as it is known Data include primary production, zooplankton (biomass, abundance, respiration), and benthos (biomass, abundance, respiration)

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

The shelf area can be distinguished into three faunistic provinces which are reflected in the phytoplankton, zooplankton, and benthic communities as well

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

RUSSIAN-GERMAN COOPERATION LAPTEV SEA SYSTEM 2000: THE EXPEDITION LENA'99

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In this poster, we present a summary of the expedition LENA'99, which was carried out within the framework of the Russian-German cooperation "System Laptev Sea 2000" From the end of April to the middle of September 1999, a total number of 42 Russian and German scientists, which were divided into 8 teams, focused on modern processes and the environmental history of the Lena Delta, the New Siberian Islands and the Laptev Sea coastal region

The first group, consisting of teams 1-3 (winter, spring, and summer), concentrated on modern processes of permafrost-affected soils, i e , the budget of methane and carbon dioxide, the influence of microbial communities, and the water and energy flux in the active layer This group had its base at the biological station Samoylov, which is a small island in the central part of the Lena delta

Teams 4 and 5 focused on the sedimentary and environmental history of the Lena delta Team 4 concentrated on the investigation of deep lakes in the western part of the Lena delta (Arga Island) During winter, sub-bottom profiling was carried out by ground penetrating radar Permafrost drilling equipment was applied to recover lake sediment cores Team 5 carried out geomorphological studies in the southwestern part of the Lena delta (Olenyokskaya Channel) Ice complexes in this region were sampled for dating and sedimentological investigations

Team 6 was based on the small RV "Dunay" Several key locations along the Laptev Sea coast were studied in regard of coastal erosion Geodetic measurements of the coast lines were carried out, detailed shoreface profiles were obtained by echosounding, and shallow seismic was applied to identify sub-sea sedimentary and permafrost structures

Teams 7 and 8 concentrated on paleoclimatic and paleoenvironmental reconstructions based on multidisciplinary investigations of selected permafrost profiles Geocryological field studies of natural exposures and detailed sampling of permafrost sections for laboratory work were performed on the New Siberian Islands (Bolshoy Lakhovsky) and in the eastern part of the Lena delta (Bykovsky Peninsula)

SOIL MICROBIOLOGICAL STUDIES IN AN ARCTIC TUNDRA ENVIRONMENT

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Soil bacteria are an important decomposer of organic material and so they are as well important producer of gases (e g , CO_2, CH_4) which play an important role for climate change In Arctic areas with permafrost-affected soils, microbiological activities are found mostly in the short summer thawing period in the active layer

The objective of this study is to describe where and how many bacteria in different soils are present and to find out which parameters control their distribution in depth An additional aim is to analyze the properties of the microbiological communities, especially those parameters which can be derived from the results of cell counting

In 1998 and 1999, several samples were taken at different sites of a low-centered polygon in a typical wet tundra ecosystem In 1998, only the border of the polygon was sampled In order to have an exact distribution of bacteria in depth, samples were taken in 2-cm steps In 1999, we dug a transect through a polygon and three different sites were chosen for more detailed investigations on bacterial distribution To transfer the data to the whole polygon, a sample site in the border region, at the slope, and in the polygon center were chosen Samples were taken from every horizon and, furthermore, from the frozen soil beneath the permafrost table

In the laboratory, bacterial cells were counted with the direct-count method after staining the bacteria with acridinorange Until now only samples from 1998 could be analyzed and we can see the typical bacterial distribution with depth in permafrost sites In the upper horizons and in the layer above the permafrost table, one can find the highest amounts of bacteria, while there are only a few (often 10 times less) in the intermediate horizons

SEDIMENTATION AND ENVIRONMENTAL HISTORY OF THE LENA DELTA

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The Lena river draining to the Siberian Arctic is considered to be the main sediment source for the Laptev Sea Nevertheless, for the delta of the river Lena occupying an area of 28,000 km^2 there are many unsolved questions concerning the environmental and sedimentation history, genesis of deposits, permafrost distribution, and climatic records in the area

To understand the sedimentation and environmental history of the Lena delta, different geological and geophysical approaches have been applied In the eastern part of the delta where modern sedimentation takes place, sedimentary and permafrost structures have been sampled by shallow coring of frozen flood plain deposits and thawed natural exposures The

mineralogy and geochemistry of the sediment sequences indicate the general development from river bedload to suspension load bedding The hydrochemistry of the permafrost documents that Holocene conditions of accumulation and deposition are controlled merely by fluvial processes and any marine influence on modern delta sedimentation can be excluded The age determinations for the late Holocene deposits are based on AMS radiocarbon dating

In the western part, sandy sections have been sampled at thawed exposures and in permafrost sediments with the aid of a drilling machine Applying the same sedimentological methods the western deposits show a sedimentary nature indicating a pure bedload sedimentation representing a fluvial stage of the late Pleistocene age according to AMS dates

Geophysical methods have been carried out to extend local sedimentological investigations The geophysical methods of sub-bottom profiling were two-fold (1) A sediment echo sounder was used as high-frequency pulse source for high resolution seismic surveying of sediments of Lake Nikolai in the western Lena delta It was possible to characterize the geometry of basin fills and changes in lake sedimentation as well as to identify the permafrost table below talik zones (2) A second coverage for Lake Nikolay was yielded from the winterly ice cover with a RAMAC impulse radar system It proved to be a viable technique for the mapping of lake sediments as well as permafrost subsurface structures on land The 25 and 100 MHz radar signals penetrated the permafrost down to about 60 m at maximum showing continuous fluvial layering and periglacial features like ice wedges To identify the sedimentary composition, sampling of lake sediment sequences was done by shallow coring into the talik and the permafrost deposits

COASTAL EROSION IN THE LAPTEV SEA AND DM. LAPTEV CHANNEL: GEOCHEMICAL EVIDENCE OF A TERRESTRIAL SIGNAL IN THE SEA

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Any attempt to understand the effect of the Arctic Ocean on global change or the effects of global change on the Arctic Ocean requires a thorough knowledge of the coastal processes as a linkage between land and ocean processes in the Arctic The coastal zone plays an important role in the Arctic land-shelf-basin system because the major transport of freshwater and solid material into the Arctic Ocean is determined by

1) the riverine runoff from Eurasia and North America, and
2) coastal erosion

The runoff sets up an estuary circulation that creates nutrient traps that help to increase primary production to up to 100 times higher than in the surrounding water

Another source of nutrients that limit shelf-productivity is coastal erosion and permafrost degradation The mean rate of the coastal retreat along the Laptev Sea coast is estimated to be 4-6 meters/year (Grigoriev and Kunitsky, personal communication) and up to 40-60 meters/year in coastal ice complexes, "ice islands" and capes (Are, 1989, Tomirdiaro, 1996) usually during the summer season that delivers particulate and dissolved matter during a period of maximum productivity In our survey in the Laptev Sea (1994,1997-98), coastal erosion is a similar source of terrestrial organic matter in riverine input Our preliminary measurements (C-13, C_{org}, N P ratio, and dynamics of the carbonate system) indicate that the biogeochemistry of the bottom water in the coastal zone (east of Lena delta) is influenced by the income of terrestrial organics and their oxidation The offshore export of terrestrial organic matter with high C N ratios may enhance the C N ratio of the dissolved and particulate organic pool in shelf and Arctic surface waters

Process-oriented studies will be done in summer/fall 1999-2002 to determine the relationship between variations in environmental and biological parameters and the production and fate of fixed carbon throughout the shelf ecosystem in the Laptev, East Siberian, and Chukchi seas

MULTI- OR INTERDISCIPLINARY? SOME THOUGHTS ABOUT THE CURRENT LAPTEV SEA SYSTEM PROJECT AND PRIORITIES OF FUTURE RESEARCH

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The significance of the Russian-German co-operative project "Laptev Sea System 2000" (LSSP) and several previous related programs for the understanding of various aspects of the past and modern environment in the Siberian Arctic is beyond any doubt The broadest thematic scope of the LSSP, the involvement of numerous institutions and research groups from both countries, and the tremendous amount of new material obtained make this project one of the most powerful research efforts in the Arctic "Multidisciplinary approach" is one of the principles of the project design and activities which makes the LSSP open for almost every research topic related to the Laptev Sea and its surroundings

Under such a broad framework, it is quite natural that some misunderstanding arises between the participating research units, a locking of some research groups at narrowly specialized problems and an insufficient interaction between the teams involved in different parts of the project Some parts of these phenomena are of administrative character and are related to the different research traditions in the two countries and the specific bureaucratic features between and inside them The main part of the controversies, however, more closely relates to the project infrastructure and research planning

The main "poles of inner tension" , or insufficient interaction, are seen in the following lines

marine versus terrestrial research,
modern versus past natural processes studies,
geological versus biological approaches

The objective existence of these poles of tension does not mean that there are no attempts to overcome the problems of that kind and some of them are very successful and effective It seems, however, that we should attach more importance to the discussion of these problems, especially for future research

One of the main directions of successful coping with these controversies lies in the research planning and defining of research priorities There are several major research problems where the interests of different groups of scientists are crossing One of these problems actually forms a natural interface in time and space between all the research directions involved

This is a problem of the last environmental collapse in the Arctic at the Pleistocene/Holocene boundary - shelf flooding and the origin of the modern shelf sea, its hydrodynamic and biotic systems, which essentially affected the whole Arctic Ocean and the land adjacent to the Laptev Sea, the breakdown of the Pleistocene terrestrial ecosystem and the development of the modern one, major changes in climatic, denudation, and sedimentation patterns Here lies the boundary of two different worlds of the past and modern Arctic and the processes that occurred at this boundary in a geologically extremely short period of time were of catastrophic rate and major scale

I suggest to discuss how we can provide a real concentration of research efforts around this problem The main idea is to organize the studies in such a way that it would be an interdisciplinary work on a major problem and not just a multidisciplinary research in the same region Several steps in this direction are already being made, others should be discussed at free opinion exchange at the round table

COMPOSITION OF AEROSOLS IN THE MARINE BOUNDARY LAYER IN THE LAPTEV SEA IN SUMMER

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Numerous studies have shown that the aerosols in the Arctic are of importance for atmospheric chemistry and the climate There is much evidence that atmospheric inputs contribute significantly to the chemical budget of marine areas To date, there is only limited information available on the composition of the aerosols in the Russian sector of the Arctic During the ARK-XI/1 expedition of RV "Polarstern" to the Laptev Sea, 12 samples of the aerosols in the marine boundary layer were collected by filtration of air through AFA-HA filters in July-September 1995 Additionally 2 samples were collected by nylon meshes These data are compared with the results of our 8 expeditions in the Russian Arctic in 1991-1998 and with literature The elemental composition of the samples was determined by instrumental neutron activation analysis The back trajectories of air masses for the sampling sites have been calculated The average atmospheric concentrations of most of the chemical elements are within the limits known from the literature for other Arctic regions The contents of heavy metals in our samples are higher than in the Antarctic and in the remote ocean regions, but they are much lower than those from seas in highly industrialized regions The temporal variations of the element concentration are caused by various air masses coming to the Laptev Sea area The increase of the concentrations of some elements in remote areas covered by ice could be explained by the resuspension of particles from sediment-laden ice

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INFLUENCE OF ENVIRONMENTAL CONDITIONS ON MACROZOOBENTHOS IN THE LAPTEV SEA AND ADJACENT WATERS

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The structure and distribution of benthic communities and their relations with environmental factors are analyzed on the material of the expeditions to the Laptev Sea carried out in 1993-1995 Complexely organized bottom communities with a high diversity of feeding types and dominated by *k*-strategists have high biomass stocks Their spatial distribution does not indicate any strong relationship with depth and grain-size composition of bottom sediments Such high values of zoobenthos biomass are noted along the northeastern coast of the Severnaya Zemlya archipelago, to the northeast of the Anabar Bay and north of Kotelnyy Island In these areas, the near-bottom salinity varies, predominantly, between 32 and 34 psu and does not fall below 30 Concentrations of dissolved oxygen in the near-bottom water exceeding 80 % and partially oxidized sediments with average Laptev Sea contents of organic carbon (0 5-1 0 %) are typical of these areas In general, their spatial distribution follows the configuration of prolonged recurrent polynyas in the sea

The combination of these specified conditions suggests that the high primary productivity in the ice edge and polynya areas is the major factor responsible for maintaining high zoobenthos biomass in the above-mentioned areas in the Laptev Sea Phytoplankton in these areas is the source of easily assimilated organic matter for the

benthic animals and, together with new bottom water formation, the source of oxygen indispensable for all biochemical processes The in situ produced organic matter substantially differs from the organic particles flowing to the sea with the river runoff

In the Laptev Sea, the allocation of relatively notable values of zoobenthos biomass is limited to the zone from the mentioned polynyas to the south - i e , the zone of annually recurring phytoplankton vegetation, but except the areas directly influenced by river runoff with poor near-bottom oxygen concentrations This feature essentially distinguishes the Laptev Sea from such sufficiently studied seas as the Barents and Chukchi seas, though the absolute values of zoobenthos biomass there are comparable

BIRD AND MAMMAL FAUNA OVER THE LAPTEV SEA POLYNYA IN SPRING

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Two spring seasons were devoted to the bird and mammal observations at the Laptev Sea polynya We used the method of aerial surveys with the helicopter MI-8 and made visual observations from both the fast and drift ice edge Early spring investigation in April-May 1999 indicated only the presence of marine mammals at the polynya at this time Four marine species, walrus (Odobenus rosmarus), bearded seal (Erignathus barbatus), ring seal (Phoca hispida), and polar bear (Ursus maritimus), and one terrestrial species, Arctic fox, (Alopex lagopus) inhabit the polynya area and the adjacent ice The number and distribution of mammals were studied in early spring The late spring period of the late May 1996 was characterised by both mammals staging and intensive marine bird migration over the polynya area Long-tailed duck (Clangula hyemalis), king eider (Somateria spectabilis), pomarine squa (Stercorarius pomarinus) and kittiwake (Rissa trydactila) were common over the open water of the polynya, while seabirds, apparently gullemot (Uria sp), and snow bunting (Plectrophenax nivalis) were vagrant The bird migration from the Bering Sea winter sites to Siberian breeding grounds occurs in late spring across the system of East-Siberian polynyas including the Laptev Sea polynya The previous suggestion that the Laptev Sea polynya serves as a long-used stop-over site of the birds was not confirmed

MODELLING THE PATHWAYS OF THE RADIONUCLIDES ^{10}BE, ^{230}TH AND ^{231}PA IN HIGH NORTHERN LATITUDES

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The radionuclides ^{10}Be, ^{230}Th, and ^{231}Pa are important tools for the reconstruction of the paleo conditions in the Arctic Ocean While ^{10}Be has an atmospheric source, ^{230}Th and ^{231}Pa are produced in the water column by the decay of dissolved ^{234}U and ^{235}U

In our study, we developed a model to reconstruct the pathways of these nuclides in the Arctic Ocean Therefore we divided this region, considering the bathymetry, in several boxes These boxes are the central Arctic Ocean (Eurasian part), the continental slope and shelf areas (Barents, Kara, Laptev) and the Norwegian and Greenland seas Based on this divison, our model was developed to determine the ^{10}Be, ^{230}Th, and ^{231}Pa depositional fluxes and concentrations (or activities) in the water column of each box As sources and sinks of these radionuclides, we considered the atmospheric input, the production in the water column, riverine input, the residence times in the water column, scavenging processes, advective watermass exchange between the boxes, radioactive decay, and sedimentation The modelling results were compared with the measured concentrations (or activities) in the water column and the recent depositional fluxes determined by radionuclide

profiles of sediment cores in each box These results show that the recent pathways of these nuclides can be rebuild by our model Thus we can apply this model to earlier Oxygen Isotope Stages to find out which predominate conditions lead to the determined depositional fluxes

Therefore we can conclude that the considered nuclides give us the opportunity, because of the different sources and residence times in the water column, to reconstruct the paleoclimatic conditions in high northern latitudes

BIVALVE ASSEMBLAGE STUDIES ON THE LAPTEV SEA SHELF AND THEIR RELATION TO WATER MASS CHANGES DURING THE HOLOCENE

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Since bivalves represent one of the most abundant groups of seabed fauna the study of the downcore distribution of bivalve assemblages provides certain evidence of the sea level and water mass changes The distribution of modern biocoenoses over the Laptev Sea shelf follow the main water masses succession from the freshened estuarine water mass (biocoenosis with predominance of *Portlandia arctica*) to nearly normal marine shelf water masses marked by relatively diverse biocoenosis with *Tridonta borealis, Leionucula bellotii, Nicania montagui, Nuculana lamellosa*, etc and, further northward, with relatively deep-sea species *Dacrydium vitreum, Arctinula groenlandica, Yoldiella fraterna*

Bivalve assemblages of the cores located in different parts of the Laptev Sea shelf document a gradual sea level rise and dispacement of water masses The oldest assemblage (around 13 ka) was found in the western Laptev Sea (270 m water depth) It consists of *Portlandia arctica* shells solely The underlying 1 5 m of sediment sequence enriched in quartz and muscovite is barren of molluscs and other organic remnants except rare planktic and benthic forams in its lowermost section Thus, prior to the beginning of postglacial transgression, severe environmental conditions with a high sedimentation rate were replaced by cold waters freshened by meltwater of outlet glaciers flowing from the adjacent land (layers with *Portlandia arctica*)

Several assemblages were described corresponding to the initial stage of the postglacial transgression Assemblages dominated by *Portlandia arctica* were recorded in the lowermost sections of the cores located in the Yana (51 water depth, ca 10-9 ka) and Khatanga-Anabar (61 m water depth, ca 11 ka) paleovalleys Such a taxonomic composition may indicate that the sediments accumulated in a brackish environment probably due to the close vicinity to the river mouths at that time Downcore samples from the slope further east (114 m water depth, age ca 10-8 5 ka) contain a diverse species assemblage - *Yoldia amygdalea hyperborea, Leionucula bellotii, Macoma calcarea, Portlandia arctica, Thyasira gouldi, Arctinula islandica, Ciliatocardium ciliatum* Its taxonomic composition is in general similar to the modern seabed assemblages of this area

Portlandia arctica predominates in all downcore samples (past 6 ka) of the core from the eastern Lena delta (20 m water depth) This is quite reasonable, since the core is located close to the delta All the lowermost samples (from 130-133 cm down to the base) include only *Portlandia arctica* Thus, molluscan assemblages of the lower core sequence possibly reflect the cold and freshened environmental conditions typical of near-estuarine areas The gradual increase of species diversity corresponds to a sea level rise

In general, the upper 4 meters (ca 9-4 5 ka) of the core section in the Yana valley (51 m water depth) display an intercalation of several species typical of the shallow coastal regions (*Leionucula bellotii, Portlandia arctica, Nuculana lamellosa, Macoma sp , Musculus niger*) thus giving evidence for a relative sea level rise

As is evident from the above brief description, the most striking feature of the downcore distribution of fossil bivalves is the predominance of *Portlandia arctica* observed in the

lower part of many cores This probably reflects an environment freshened by river runoff during the postglacial transgression The upper core sequence usually displays increasing taxonomic diversity of molluscan assemblages The latter consist of the same species as found in the modern biocoenoses

MATHEMATICAL MODEL FOR INVESTIGATION OF PERMAFROST AND GAS HYDRATE BODIES INTERACTION

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A two-dimensional finite differences conductive heat transfer model with phase change was applied to investigate the dependence of formation and evolution of both the permafrost containing unfrozen water and the gashydrate stability zones (GHSZ) on two essential exterior conditions The first one is the long-term temperature variation on the surface of the lithosphere, the second is the variable hydrostatic pressure due to sea level regression/transgression Fluctuations of the temperatures on the surface and sea level were reconstructed on the basis of isotopic curves from Vostok station (Antarktic)

The model was used to estimate the Northern Yakutian lowlands and enclosed shelf permafrost and the GHSZ evolution during the last 400 000 years It is noted that during thermochrons on the land and transgressions on the inner part of the shelf (water depth less than 40 m), there was no significant thawing of the permafrost and decomposition of the GHSZ

THERMOKARST AND ITS ROLE IN SEA-LAND INTERACTION ON THE LAPTEV SEA SHELF

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Ice-rich syncryogenic permafrost known as Ice Complex was formed during the Late Pleistocene regression on the drained Laptev Sea shelf and its surrounding lowlands Its thickness reaches a few tens of meters and in wide areas, its floor is situated below the recent sea level During about 13000 years BP, thermokarst processes started to destroy the Ice Complex and formed numerous thermokarst lakes Further, due to the sea transgression, thermokarst lakes and alases depressions were transformed into thermokarst lagoons The transformation of thermokarst lakes to thermokarst lagoons is going on now, for example, in the Yana delta and on the Bykovsky Peninsula

One such lagoon on the Bykovsky Peninsula was investigated in the frames of the Lena delta Expedition in May, 1999 It is separated from the sea by the spit and it has salt water The profile across the lagoon showed that the lagoon depth is 2 - 3 meters The thickness of winter ice cover is 2-2 4 m Temperature measurement showed that a negative temperature of the floor ground is up to 7 m below the lagoon bottom The upper boundary of permafrost reached up to 16 4 m Thus, the thickness of the talik under the thermokarst lagoon is only 9 4 m in winter now We are considering that after the thermokarst lagoon origin, talik freezing started This is confirmed by the results of computer mathematical simulation They showed, that the thickness of the lake talik was not more than 150-200 m and for its complete freezing needed 1000-1500 years

There are the thermokarst lakes near the Laptev Sea coastline which have the floor level below the recent sea level In the future, these lakes can be transformed into thermokarst lagoons IThe investigation of these formations is very important from the point of view of the study of the past and future history of the Laptev Sea shelf and its surrounding lowlands

INFLUENCE OF THE LENA RUNOFF ON THE PHYTOPLANKTON COMMUNITIES IN THE LAPTEV SEA STUDIED DURING THREE SEASONS

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The Lena, one of the major rivers discharging freshwater to the Arctic Ocean, has a major influence on the living conditions of the phytoplankton in a wide part of the shallow Laptev Sea The pulsed outflow through the year leads to a changing environment, visible in many abiotic factors, e g , salinity and silicon concentration These changes should be reflected in the qualitative and quantitative composition of the phytoplankton Phytoplankton samples were taken during three TRANSDRIFT expeditions (TD) in autumn 1995 (TD III), spring 1996 (TD IV), and summer 1998 (TD V) on the shelf of the Laptev Sea Analyses for phytoplankton species inventory, as well as for abundance and biomass (in terms of phytoplankton carbon and chlorophyll a) were carried out Additionally during summer 1998, primary production was measured using an in situ incubation method and the bacterial biomass was quantified.

The results show a strong influence of the Lena river water on the phytoplankton communities during spring 1996 and summer 1998 in all examined parameters The community analyses distinghuished during each season two communities, one was located close to the Lena delta, the other lay further north In the southeastern Laptev Sea, euryhalin phytoplankton species prevailed, being able to live in a wide range of environmental conditions It could be shown by means of factor analysis that the Lena is the main factor influencing the pelagic environment in the southeastern Laptev Sea in summer 1998 No influence of the Lena was found in our samples taken in autumn 1995 when the sampling took place during the period of new ice formation

Summarizing, the strong influence of the Lena was only visible during the seasons (spring and summer) when the discharge rate of the river is usually high

PHYSICAL CHARACTERISTICS AND CRYSTALLINE ICE STRUCTURE IN THE WINTER/SPRING PERIOD OF 1998-99 IN THE SOUTHERN PART OF THE LAPTEV SEA

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The physical characteristics of ice and its crystalline structure have been studied in April-May 1999 in the southern part of the Laptev Sea as a component of the TRANSDRIFT VI expedition carried out in the framework of the Russian-German project "Laptev Sea System 2000" These investigations helped to determine the variability of properties and associated processes in the land-fast and drifting sea ice in the flaw-polynya region, both during the time of the expedition and the entire ice-growth period (as derived from the core stratigraphy) Of particular interest are the dynamic factors that influence the character of ice growth and formation Among these we can distinguish

- processes of frazil and slush ice formation that produce typical small-grained crystal layers in the vertical ice structure, and
- steady surface currents that can also cause clearly expressed changes in the crystalline ice structure, such as an azimuthal alignment of fibrous crystals, characteristic for the fast ice, with a C-axis orientation parallel to the direction of the current

Furthermore, these investigations allowed us to assess the extent of changes in the state of the ice cover during the transition from the winter to the spring regime These thermometamorphic changes are generally quite substantial and hence have a distinct impact on the entire hydrometeorological and sea-ice regime at this time of the year.

The stratigraphic information about the evolution of the ice crystalline structure throughout the period autumn-winter 1998-99 allows to make some conclusions about the prevailing hydrometeorological regime as well as deviations from it Among the latter, the development of a flaw polynya and low winter air temperatures are most significant The most interesting results include the following observations

- the development of a distinct azimuthal alignment of the crystals in the middle and lower ice layers under the influence of the prevailing current regime, with geostrophic and thermohaline components, with the latter driven by the hydrodynamics of the flaw polynya,
- the absence of incorporations of frazil and slush ice crystals into the ice column in the fast ice as well as in the drift ice in the immediate vicinity of the polynya,
- the radiational warming of the lower ice layer of a thickness of 2 to 7 cm up to a temperature above that of the surface water layer by an amount of up to 0 5^{0}C,
- the intensive formation of vertical cracks during ice coring, promoted by some peculiarities of its physical state (rather low ice temperatures and small amount of air inclusions) and the distinct spatial alignment of the crystals in the middle and lower layers

These results thus indicate that with the weak development of a flaw polynya in some years, ice formation in its immediate vicinity occurs in a stable hydrometeorological regime, with the ice crystalline structure and physical properties conforming with the characteristic fast ice stratigraphy.

ANTHROPOGENIC POLLUTANTS IN THE WESTERN PART OF THE LAPTEV SEA: ATMOSPHERIC CONCENTRATIONS AND FLUXES ONTO THE SURFACE

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The 5-day forward and backward trajectories of air mass transport for one point at the archipelago of Severnaya Zemlya (79°50'N, 95°40'E) have been analyzed for each day of January, April, July, and October during 1986-95 The main features and seasonal differences in air exchange processes between the Arctic and the mid-latitudinal regions were investigated Taking into account the seasonal variations in aerosol scavenging mechanisms and velocities, the contributions of the large industrial regions to the Arctic air pollution were estimated for different seasons Good correspondence between the calculated mean concentrations of some anthropogenic chemical elements (As, Ni, Pb, V, Zn, Cd) and the experimentally measured ones has been obtained The annual variations in the mean balance of a passive impurity in the atmosphere of the central Russian Arctic side was estimated The shares of passive impurities, passing through the observation point and scavenging then in the Arctic, are between 40 to 60% in winter and spring, and more than 90% in summer About 20% of the passive impurities, coming into the Arctic in winter and spring seasons, are brought out then by the air masses from the Arctic to the continents or the oceans Such effect may be also regarded as the sink of pollutants from the Arctic atmosphere The monthly and annual average fluxes of anthropogenic elements onto the surface near the observation point were calculated As a result, the annual average element mass depositions onto the Laptev Sea surface were roughly estimated

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APPLICATION OF GROUND PENETRATING RADAR FOR HIGH RESOLUTION MAPPING OF PERMAFROST SOILS

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During the expedition LENA'99, Ground Penetrating Radar (GPR) was used on Samoylov Island (Lena delta) to gain information on the composition and variability of permafrost soils The goal was to investigate the small scale textural changes (cm) in the active layer and the uppermost part of the frozen ground during thawing and the differences connected with the specific structure of polygons (wall and center) Periodic measurements were carried out from June to July when soil condition changes from totally frozen to the maximum thaw depth of the active layer A RAMAC-GPR system with different antennas (100MHz, 500MHz, and 800MHz) was applied Soil velocities received from Common Midpoint (CMP) measurements with the 100MHz antenna were compared to dielectric values determined by Time Domain Reflectrometry (TDR) from various sites

The thickness of the thawed layer was determined by periodic measurements with the high frequency antennas (500/800MHz) The seasonally changing thaw depth in the polygon center is well detected due to the very different electrical properties of water and frozen ground The radargrams recorded with the 100MHz antennas give the best results

CMP with 100MHz and TDR measurements were carried out simultaneously to calculate a vertical velocity profile which is needed to transform the recorded travel time scale to depth scale Additionally, the depth of the active layer was measured by manual probing for velocity calculation in this part of the section All the results were compared

As a summary, GPR is a good method to investigate the active layer and its thawing For best results, antenna frequencies should be chosen very carefully Furthermore, velocity CMP measurements with the 500/800 MHz antennas should be determined

SEASONAL EMISSION OF METHANE FROM A POLYGON TUNDRA - BIOGEOCHEMISTRY AND MICROBIAL PROCESSES

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Within the scope of the Russian-German cooperation "Laptev Sea System 2000", the multidisciplinary soil and microbiological studies are focused on the seasonal variability of the modern carbon fluxes in the permafrost region of the Lena delta The big organic carbon pools of the Siberian permafrost soils play an important role for the prediction of future climatic influenced processes Especially the carbon fixation in cryosols and the release of climate relevant trace gases like CO_2 and CH_4 due to the carbon decomposition are important for the global carbon budget But the exact size of this source, however, is still uncertain

The investigations on Samoylov, a representative island in the Lena delta (N 72° E 126°) includes field measurements of the methane and carbon dioxide emission of a typical ice-wedge tundra and the process studies of methane fluxes (production, oxidation, emission)

The closed chamber measurements of methane emission from the centre of a wet polygon tundra showed right from the start of soil thawing a relatively high CH_4 emission rate (> 15 mg h-1 m-2) at the beginning of June, which increased with the continuing

thawing of the active layer The highest methane emission was observed during July with a rate between 70 - 80 mg d-1 m-2 The maximum thaw depth of the soil was reached in August During this period, the methane emission decreased again because under these conditions, the microbial methane oxidation became more important In contrast to the polygon center, the methane emission from the border was lower than 6 mg d-1 m-2 during the whole season It is concluded that the variations in the thickness of active layer, in soil moisture as well as the kind and the stocking density of the plant cover are the most important reasons for the seasonal and spatial differences of the methane fluxes from permafrost soils

The investigation of in situ methane production activity showed that methane formation occured already at the bottom of the active layer at temperatures between 0 6 and 1 2 °C The vertical profiles of the methane production rates and soil temperature of different sites indicated that methane formation is more or less independent from in situ temperature Therefore it seems to be possible that in cryosolss a methanogenic comunity exists, which is addapted to the low *in situ* temperatures This would be of great ecological significance because methane formation is the last step of anaerobic decomposition of soil organic matter The isolation and characterization of methanogenic and methane oxidizing bacteria, which is still in progress, should clarify the physiological potential and ecological significance of these microorganisms.

VARIABILITY OF OCEANOGRAPHIC PARAMETERS IN THE ARCTIC COASTAL ZONE ; THE LAPTEV SEA SYSTEM

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The preliminary results of the 3rd Laptev Sea expedition of Lab Geochemistry in the Polar Seas(LGPS)/Pacific Oceanological Institute obtained during September 99 are presented The southeastern part of the Laptev Sea and Dm Laptev Strait/East-Siberian Sea were surveyed (STD and currents) It was found that temperature is decreased near the coastline Two-three layer currents were measured in the shallow waters The results will be used to evaluate and simulate particulate (organic/inorganic forms) matter transport in the land-shelf system with high rates of the coastal retreatment that is a scientific topic of the LGPS in 1998-2003

RADIATIVE-CLIMATIC RESEARCHES IN CENTRAL ARCTIC REGION

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One of the priority places of World Climate Researches Program is the radiative heat exchange in an atmosphere and on a terrestrial surface It is known that radiation heat exchange of solar and terrestrial radiation is the main reason of the majority of processes proceeding in an atmosphere and ocean In turn, changes of the radiating characteristics of an atmosphere due to changes of concentration of radiatively active gases, the aerosol concentration (tropospheric and stratospheric) and albedo of a terrestrial surface (change of the areas of snow-ice covers) cause directly changes in the climatic system, including the general circulation of the atmosphere So, the monitoring of the components of radiating balance and radiating characteristics is simultaneously indicator and predictor of the change of the climatic system Changes in the Arctic region of the radiation characteristics of an atmosphere and terrestrial surface influence the climatic conditions more than in other areas It has been traditionally assumed (and testified to by observational results) that the Arctic atmosphere is exceptionally clean and transparent However, starting from the early 1950's

a large-scale inflow of aerosol masses into the lower and middle troposphere of the wintertime Arctic was discovered, mainly - from mid-latitude Eurasia and North America, leading to a decrease of the atmospheric transparency in the region The tendency to larger amounts of light-absorbing aerosols in the Arctic necessitates studying the possible climatic effect of such a development This effect may be manifested both directly - the aerosol being a radiatively active atmospheric component, and indirectly - since the aerosol affects the processes of cloud and haze nucleation. In this connection the hypothesis was put down that Arctic Haze can render appreciable influence on the longwave of radiation in an atmosphere, in winter during polar night and early spring But it is difficult to obtain definite quantitative estimates from model simulations of this effect since the radiative properties of aerosols are poorly known as yet, particularly those of the troposphere dust in the infrared range For a check of this hypothesis in the Central Polar Basin, the radiating experiment was carried out Observations of the RBC were organized in the Arctic Ocean on the North Pole - 28 drifting station from February to October 1987, between 81-85°N and 140-170°E

Surface measurements of the longwave atmospheric radiation were conducted with the experimental spectral pyrgeometers On the basis of conducted measurements and calculated the parameters of atmospheric emissivity, describing the aerosol effect in a IR-range of radiation, and the parameters of relative aerosol extinction of direct solar radiation were received The data of the direct measurements of the aerosol characteristics on the Spitsbergen archipelago and the ones indirectly determined by optical methods on Cape Barrow in addition were involved in the analysis In summer time, the data of aerosol measurement consentration in all regions of the Arctic are very close, as it was shown in the expeditions on RV "Polarstern" 1995, TRANSDRIFT III and set The outlined proxy indicators of the effects of aerosol pollution upon the radiation budget components at the Earth surface, particularly – upon its longwave part, testify in favor of the hypothesis assuming an additional radiative effect of the sub-inversions haze during the Polar night and early spring Numerically this effect consists of an increase of atmospheric longwave radiation at a surface of ground of 15-20W/m^2 The measurements and model calculations have allowed to reconstruct an annual variability of cloudiness, showing that the influence of Arctic Haze is comparable to the increase of low cloudiness of 10 %, or with the doubling of carbon dioxide in polar areas

PROPOSAL FOR CREATION OF A COMPUTER MODEL OF CIRCULATION OF WATER MASSES AND SEDIMENTS NEAR THE COASTAL ZONE OF THE LAPTEV SEA

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The amount of the supply of sediments by the rivers, running to the Laptev Sea, directly ahead of deltas by ramifyings, is estimated approximately in 26 million t (21 million t sediments are carried out by the Lena river) The large part of sediments is put aside in the deltas of the rivers Approximately 25-50 % are layed up on the surface of bars On the marine edge of a delta, the sediment mass is transported by forces of the marine currents The amount of sediments from destroyed sea shores arrives in the sea, too It can be the same amount However, a large part of the coastal line of the Laptev Sea consists of river sediments Thus, the role of the rivers influences the process of sedimentation at sea shores It is necessary to mark that the main factor, responsable for the morphological structure of a river channel, is the flow component This is the main force responsable for the transportation of the material, by analogy to the rivers The causes of the coastal flow may be different spring, wind, salinity, thermal circulations, or the input of the seasonal flow of the big rivers

The amount of the sediments coming from floodplane and terraces of river and sea shores is a huge component For example, the discharge intensity of the shore sediment mass

arriving in a channel is twice more than the sediment discharge of the river material The greatest part of the material of shores is accumulated A similar picture should be observed in places of the destruction of marine shores. We can study the disposition of erosion and accumulation areas creating a computer model of the circulation of the waters of the Laptev Sea depending on ice conditions The shallow-water theory is used for the solution of the fluvial hydraulics task The plane problem in hydraulics is mathematically described by a nonlinear system of differential equations of Saint-Venant where only numerical integration is allowed The models of the circulation of the water masses of the Aral and the Caspian seas can serve as an example

SPATIAL - TEMPORAL VARIABILITY OF SEA LEVEL IN THE LAPTEV SEA IN SUMMER FROM ERS-1/2 ALTIMETER DATA

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The mean sea surface topography in summer in the Laptev Sea was collected for a 4-year period (1993, 1995-1997) using combined TOPEX/POSEIDON and ERS-1/2 altimeter products, produced by the CLS Space Oceanography Division as part of the European Union' Environment and Climate project AGORA (ENV4-CT9560113) and DUACS (ENV4-CT96-0357) with financial support from the CEO program (Centre for Earth Observation) and Midi-Pyrénées regional council CD ROMs were produced by the AVISO/Altimetry operations center The ERS products were generated as part of the proposal "Joint analysis of ERS-1, ERS-2 and TOPEX/POSEIDON altimeter data for oceanic circulation studies" selected in response to the Announcement of Opportunity for ERS-1/2 by the European Space Agency (Proposal code A02 F105) These altimeter data were received by the author with Professor O M Johannessen's assistance (NANSEN REMOTE SENSING CENTER Bergen Norway)

The map of the mean sea surface topography in summer shows that a low level area may be observed in the south of the sea and high sea level regions are recorded in the northern part of the sea and in the zone between the Buor-Khaya Cape and Kotel'nyy Island Incidentally, the difference in the level between these extremes is 13 cm The maximum horizontal gradients of the surface level are also observed in the zone between the Buor-Khaya Cape and Kotel'nyy Island

In order to investigate the spatial variability of the low-frequency sea-level oscillations intensity, the root-mean-square of the sea level anomaly obtained using 4 years of ERS-1/2 altimeter data was estimated These results reveal 2 zones of increased intensity of low-frequency sea-level oscillations The first zone is observed near the south-southeastern shore of the sea The second zone is extended from the Khatanga Gulf to Dunay Island and further to the region to the north off the Novosibirskie Islands The largest sea-level perturbations are registered in the Olenek Bay, near the Buor-Khaya Cape and in the eastern part of the Yana Bay The map of the root-mean-square of ERS-1/2 sea level variability is compared with estimates of the root-mean-square of sea level variability obtained using daily mean sea level oscillations at 19 coastal and island stations in the Laptev Sea Comparison shows a very large similarity between altimeter and the instrumental calculations of the sea-level oscillation intensity It was shown earlier by one of the authors that the most intensive low-frequency sea-level oscillations in the Laptev Sea are generated in the synoptical scale range (from several days to several months) and propagate to the east in the form of progressive waves The calculated velocities of these waves were close to the phase speeds of topographic Rossby waves It is quite possible, therefore, that 2 zones of the increased intensity of low-frequency sea-level oscillations observed on the map of the root-mean-square of ERS-1/2 sea level variability are connected with the horizontal mode structure of the topographic Rossby waves It is interesting that the second zone of increased sea level variability very largely corresponds to the location of the stationary Anabaro-Lenskaya, West-Novosibirskaya and Novosibirskaya flaw leads It is possible to hypothesize that this

zone of increased sea level variability could make a certain contribution to the formation of the stationary flaw leads in the Laptev Sea

In order to study the year-to-year variability of the sea surface topography in the Laptev Sea, the mean sea surface level in summer was collected for individual years from ERS-1/2 altimeter data These results show that the spatial structure of the sea level fields changes significantly from year to year The least spatial variability of the sea level is registered in the summer of 1995 while the most considerable spatial changes of the sea surface topography are observed in the summer of 1997

ANNUAL VERTICAL MICROALGAE FLUXES IN THE NORTHERN LAPTEV SEA (SEDIMENT TRAP DATA)

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For the first time, the particle fluxes in the northern Laptev Sea over the Lomonosov Ridge have been studied at the LOMO-2 annual mooring station (81°04,3'N, 138°55,2'E, depth 1703 Õ) from September 15, 1995, till August 16, 1996 The oceanographic mooring station was deployed from onboard RV "Polarstern" during its ARK-XI/1 expedition and recovered during its ARK-XII, ACYS 1996 expedition The vertical particle fluxes were measured at the depth of 150 m below the halocline and at 150 m above the sea floor with two cone-shaped multisample sediment traps The identification and counting of microalgae cells in subsamples from both traps was carried out in the chamber with volume of 0 05 and 1 cm^3 and with a magnification of x210 and x105 times To obtain A more precise identification of the species, the magnification x945 and scanning electron microscopy were used

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 These studies show significant seasonal variations of microalgae fluxes It has been shown that under a permanent ice cover in summer, various flora (consisting mainly of cryofeel diatoms) intensively develops. Great seasonal variations in microalgae flux closely correlate with solar radiation During the maximum insolation period (from the middle of July till the end of September), microalgae flux is hundreds of times higher than in other seasons The values of the summer microalgae flux in the northern Laptev Sea over the Lomonosov Ridge are close to those in the Weddell Sea (Antarctica) and are higher than summer fluxes in the Norwegian and Greenland Seas and in the Saint Anna Trough (the NW Kara Sea)

LICHENS AND THE GLACIAL HISTORY OF THE CENTRAL SIBERIAN ARCTIC

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Lichens are among the most hardy and widespread organisms However, their distribution patterns with no doubt reflect environmental history Some remarkable lichen findings in the central Siberian Arctic could be well interpreted according to the modern scenario of the glacial history of the region (e g , Kozhevnikov, 1996) The lichen species Acarospora putoranica Golubk et Zhurbenko and Lecanora gyrophorina Poelt et Zhurbenko are as yet known only from the Putorana plateau and Byrranga Mts Such a distribution area could be well understood from the point of their survival during the Sartan glaciation in the ice-free refugium between Putorana and Byrranga ice shields The same distribution pattern amongst vascular plants exhibit Taraxacum byrrangicum Kozhevnikov Lecanora geophila

(Th Fr) Poelt and Siphula ceratites (Wahlenb) Fr are lichen species characteristic of the Arctic coast-line We have found them in the Byrranga Mts , where they are locally abundant at the mountain tops Their migration to the center of the Taimyr mainland could occurre during sea transgressions in the Kargin period During the Sartan glaciation, these species could survive in ice-free periglacial areas near the Byrranga ice shield and then settle down in the Byrranga Mts From the earliest times, the Lena river valley serves as the only or the main canal of penetration of the Central Asian flora to the Arctic From the Lena delta, plants migrated along the dried shelves westwards to the Taimyr peninsula or eastwards up to Scandinavia A few surprising finds of the Central Asian lichens in the Lena delta, viz Gypsoplaca macrophylla (Zahlbr) Timdal, Lobaria retigera (Bory) Trevis , and Psora himalayana (Church Bab) Timdal, as well as the occurring of Gypsoplaca macrophylla in the Byrranga Mts, trace these migrations It is particularly remarkable that Gypsoplaca macrophylla has recently been also found in the mountains of the Norwegian north

ASSESSMENT OF HYDROLOGICAL CHARACTERISTICS OF RARELY STUDIED CENTRAL TAIMYR WATERSHED BASINS

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The aim of the studies was a quantitative assessment of the main parameters of the hydrolgical regime of the water systems in the sparsely investigated watershed basins of Central Taimyr

The main objects of studies were the basins of the Lower Taimyra River and Lake Taimyr Both of these systems govern the formation of freshwater runoff from the poorly studied basins of Central Taimyr

The hydrological data of Byrranga mountains collected in 1993-96 by the Russian-German expeditions "Taimyr -Severnaya Zemlya" (Laptev Sea System Project) were used

The data collected supplement and specify the earlier obtained data available in special literature based on short (2-3 years) observation series

The runoff from the Lake Taimyr basin was assessed from the obtained relations of the lake water levels at the gauge in Ozhidanuya Bay with the runoff modules of the Lower Taimyra Calculations covered the 1945 to 1995 period Based on the available ratios, the Lower Taimyra runoff to the sea was assessed for each month and in total by years

According to a multiyear observation series, the runoff norm of the Lower Taimyra comprised 33 2 km^3/year (Wmax=52 1 km^3, Wmin=15 5 km^3) The runoff norm for Lake Taimyr comprises 23 6 km^3 (around 73% of the Lower Taimyra runoff) The runoff modules have the following values M max avr = 43 2 l/s km^2, M0=8 3 l/s km^2 – for a multiyear series, M0=12 7 l/s km^2 – for a high water content year, M0=4 53 l/s km^2 for a low water content year

For Byrranga, an assessment of the basin water balance components, a characterization of the moisture content in snow, a determination of the runoff modules and the layer for water flows of different orders constituting the river network of middle Byrranga, and a characterization of their variability were performed (calculations were made by the example of Lake Levinson-Lessing)

The moisture content in snow at the watershed of the lake-river system studied is around 44% of the runoff with liquid precipitation comprising 32 2% For the stream network located at the steep slopes occupying about 30% of the watershed area, the moisture content in snow comprises about 77% of the runoff The average runoff layer at the watershed comprised 164 mm at the average snow density of 0 34 g/cm^3

The average annual runoff module of the Byrranga River system varied within 12-14 l/s km^2 , whereas the average annual runoff module of the regulated lake-river Byrranga system is about 40 l/s km^2 The maximum runoff module of the river system comprises 453 l/s

km^2 with the maximum runoff module of the lake-river system of 150 l/s km^2 The regulating influence of the lake is quite evident

A similar landscape complex extends over the entire middle Byrranga massif covering about 10% of the watershed basin of the Lower Taimyra River