TERRA NOSTRA

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Climate Drivers of the North

Program and Abstracts

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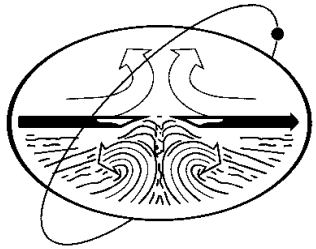
IMPRESSUM



TERRA NOSTRA
Heft 2002/3 Climate Drivers of the North

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Program

Climate Drivers of the North
Kiel, May 8-11, 2002

Program

Wednesday, May 8, 2002

15:00 - 19:00	***Registration GEOMAR, Building 8, main entrance***
19:00 - 21:00	***Icebreaker on the museum ship „Jenny“ (GEOMAR pier)***

Thursday, May 9, 2002

08:30 – 08:40	Welcome and opening by C. Dullo and H. Kassens
08:40 - 09:00	Ten years of Russian-German cooperation in geosciences Thiede, J.

Session 1: Modern processes in polar seas
Conveners: J. Hölemann, I. Dmitrenko, M. Spindler, L. Timokhov

09:00	Interannual variabiliy of summer sea ice thickness in the Siberian and central Arctic under different atmospheric circulation regimes Haas, C.
09:15	Methane contents in different compartments of the Laptev Sea - preliminary results Kobabe, S., Wagner, D., Schröder, H., Damm, E., Kassens, H., Pfeiffer, E.-M.
09:30	Climate scale variability of the arctic atmosphere and ocean circulation and its link with the arctic seas Timokhov, L., Ivanov, V., Kochetov, S., Koltishev, A., Karklin, V., Priamikov, S., Yanes, A.
09:45	The drivers of Siberian arctic shallow seas hydrography within the scale of seasonal and internannual variability Dmitrenko, I.A., Hölemann, J.A., Berezovskaya, S.L., Kirillov, S.A., Eicken, H., Kassens, H.
10:00 - 10:30	Coffee break

Session 1: Modern processes in polar seas (continued)
Conveners: J. Hölemann, I. Dmitrenko, M. Spindler, L. Timokhov

10:30	Transport dynamics on the Laptev Sea shelf: timing of seasonal processes as a control for interannual variability Hölemann, J.A., Wegner, C., Dmitrenko, I., Kirillov, S.
10:45	Seasonal sediment dynamics on the Laptev Sea shelf - Implications for sediment budget calculations Wegner, C., Hölemann, J.A., Dmitrenko, I., Kirillov, S., Niessen, F., Kassens, H.
11:00	Nutrients in the Laptev Sea System: distribution, variability, and budgets Pivovarov, S., Nitishinsky, M.

11:15	Diel vertical migrations of mesozooplankton in the Laptev Sea inferred from acoustic backscatter signal: long- and short-term variations Abramova, E., Ivanova, D., Tuschling, K., Dmitrenko, I., Hölemann, J., Akhmetshina, I., Wegner, C.
11:30	The Laptev Sea ecosystem research: now and then! Schmid, M.K.
11:45 – 12:05	Poster presentation Session 1
12:05 - 12:45	Posters Session 1 and 2
12:45 – 13:45	Lunch

Session 2: Methane venting and gas hydrates – modes and mechanims
Conveners: E. Suess, A. Obzhirov, V. Soloviev, E.-M. Pfeiffer

13:45	Hydrocarbon gases and gas hydrates in the mud volcanic deposits of the deep Black Sea, their composition and possible sources of formation Ivanov, M., Stadnitskaya, A., van Weering, T., Blinova, V., Kozlova, E.
14:00	Methane in surface sediments of the Haakon Mosby Mud Volcano Schlüter, M., Sauter, E., Boetius, A., Klages, M.
14:15	Methane distribution in the water column of the Okhotsk and Japan seas Obzhirov, A.I., Vereshchagina, O.F., Shakirov, R.B., Saluyk, A.N., Suess, E., Biebow, N., Lobanov, V.B.
14:30	Hydroacoustic flare imaging and estimation of the methane flux from an active natural methane vent area on the northern Sakhalin slope Salyuk, A., Obzhirov, A., Li, B., Biebow, N., Suess, E.
14:45 - 15:15	Coffee break

Session 2: Methane venting and gas hydrates – modes and mechanims (continued)
Conveners: E. Suess, A. Obzhirov, V. Soloviev, E.-M. Pfeiffer

15:15	Thermal signals associated with seafloor hydrate accumulations and application for investigations in the Sea of Okhotsk Poort, J., Kaulio, V., Soloviev, V.
15:30	Massive barite deposits and carbonate mineralization in the Derugin Basin, Sea of Okhotsk: Precipitation process at cold vent sites Greinert, J., Bollwerk, S.M., Derkachev, A., Bohrmann, G., Suess, E.
15:45	Rising gas bubbles in sediments – A model for mixing the porewater Haeckel, M.
16:00	Experimental investigations of gas hydrate formation and dissociation in sediments Chuvilin, E.M., Kozlova, E.V., Makhonina, N.A.
16:15	Modeling permafrost and gas hydrate stability zone in the Laptev and Eastern Siberia seas Eliseeva, A., Gavrilov, A. V., Kholodov, V., Romanovskii, N.
16:30 - 16:50	Poster presentation Session 2
16:50 – 17:30	Posters Session 1 and 2

17:30 – 19:00	Workshops

Posters

Session 1

Akhmetshina, I., Abramova, E. Zooplankton abundance, biomass and production in the Lena Delta polygon lakes: preliminary results

Aliev, T.A., Kuroshev, G.D. Usage of bathymetric maps and modern remote sensing technologies in investigations of polar seas

Berezovskaya, S., Dmitrenko, I., Kirillov, S. The Laptev Sea shelf hydrography under variable atmospheric forcing during summer

Ivanova, D., Abramova, E., Akhmetshina, I. Application of wavelet-analysis for studying zooplankton

Kirillov, S., Darovskikh, A., Dmitrenko, I. Delay in ice formation onset in the Laptev Sea: consequences of additional heat flux from the bottom layer

Kirillova, L. The water column structure in the Bering Strait

Klyuvitkin, A.A., Ponomareva, T.Ya., Shevchenko, V.P., Vinogradova, A.A. Atmospheric input of trace metals into the Laptev Sea

Krylov, A.A., Andreeva, I.A., Shilov, V., Kaban'kov, V.Ya., Mirolubova, E.S. Quaternary paleoceanography of the Mendeleev Rise, Amerasian basin of the Arctic Ocean

Luchsheva, L.N., Obzhirov, A.I., Selina, M.C., Zakharkov, S.P., Stonik, I.V., Shtraikhert, E.A., Suess, E., Biebow, N. The influence of the frontal zone of the East Sakhalin current on the development of phytoplankton and the distribution of mercury and methane concentrations in sea water

Narkevsky, E. Nutrient flux in the East Siberian Sea

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

Novigatsky, A.N., Lisitzin, A.P., Serova, V.V., Shevchenko, V.P., Stein, R. Sedimentary material transport by sea ice in the Laptev Sea and adjacent Arctic Ocean

Pavlova, G.Yu., Tishchenko, P.Ya., Semiletov, I.P., Volkova, T.I., Gukov, A.Yu. Nonconservative behavior of calcium in the Lena Delta and Laptev Sea

Peters, J., Tuschling, K. Dominance of opportunists? Feeding ecology of zooplankton as indicated by fatty acid composition

Pryakhina, G.V. New approach in the field of training specialists for the solution of problems of big cities and industrial zones

Shevchenko, V.P., Klyuvitkin, A.A., Kriews, M., Lisitzin, A.P., Nöthig, E.-M., Novigatsky, A.N., Smirnov, V.V., Stein, R., Vinogradova, A.A. Pathways and fluxes of natural and anthropogenic tracers in the Laptev Sea and adjacent Arctic Ocean

Sosnin, V., Tishchenko, P., Biebow, N. Diapycnal entrainment of shelf waters into intermediate depths across the Sakhalin continental slope (Sea of Okhotsk)

Steffens, M. Environmental factors affecting the macrobenthic community structure in the shallow eastern Laptev Sea

Terekhova, V.E., Sosnin, V., Shakirov, R.B., Obzhirov, A.I., Bouzoleva, L.S., Somov, G. Discovery of Listeria monocytogenes in the northwest of the Okhotsk Sea

Wegner, C., Hölemann, J.A., Dmitrenko, I., Kirillov, S., Klagge, T., Mörz, T., Kassens, H. Acoustic Doppler Current Profiler - a tool for the determination of sediment transport dynamics on arctic shelves

Session 2

Biebow, N., Obzhirov, A., Winckler, G., Sosnin, V., Salyuk, A., Suess, E. Seasonal variability of methane degassing at the sea floor and methane input into the atmosphere - Results from the joint Russian-German project KOMEX

Bollwerk, S.M., Greinert, J., Wallmann, K., Bohrmann, G., Eisenhauer, A., Suess, E. Pore water chemistry of vent fluids associated to massive barite deposits in the Derugin Basin, Sea of Okhotsk

Derkachev, A.N., Bohrmann, G., Greinert, J., Obzhirov, A.I., Suess, E. Barites of the Sea of Okhotsk: sedimentological and mineralogical aspects of their origin

Kaulio, V.V., Soloviev, V.A. Effect of gas hydrate formation on the geothermal field in gas-seepage areas

Kutzbach, L., Wille, C., Wagner, D., Pfeiffer, E.-M. Quantifying methane emissions from Siberian permafrost landscapes: the eddy covariance technique as a tool to determine trace gas fluxes on the ecosystem scale

Lembke, L., Tiedemann, R., Nürnberg, D., Biebow, N., Kaiser, A., Kokfelt, U., Kozdon, R. Benthic foraminiferal $\partial^{13}C$ anomalies in gravity core GE 99-24: evidence for extreme Holocene paleomethane anomalies off NE Sakhalin?

Lüdmann, T., Wong, H.K. Gas hydrates in the Okhotsk Sea - a first quantification of the associated methane

Mazurenko, L.L., Soloviev, V.A. On the composition of gas hydrate-forming mud volcano fluids

Pfeiffer, E.-M., Kobabe, S., Wagner, D. Methane fluxes in Siberia and their relevance for the permafrost related gas hydrate research

Sahling, H., Galkin, S.V., Foerstel, H., Greinert, J., Salyuk, A., Piepenburg, D., Suess, E. Interactions between cold-seep and deep-sea ecosystems on the Sakhalin continental shelf and slope and in the Derugin Basin (Sea of Okhotsk)

Shakirov, R.B., Obzhirov, A.I., Prisyazhnyuk, A.V. Gasgeochemical research of mud volcanoes on Sakhalin Island

Soloviev, V.A. Study of gas hydrate accumulations associated with fluid discharge areas: some suggestions to the Russian-German collaboration

Wong, C.S., Tishchenko, P.Ya., Johnson, W.K. Thermodynamic consideration of equilibrium of CO_2-hydrate in sea water

Yakushev, V.S., Chuvilin, E.M., Perlova, E.V. Natural gas and gas hydrate association in permafrost of West Siberia

Friday, May 10, 2002

Session 3: Records of land-ocean linkages
Conveners: H. Bauch, M. Grigoriev, A. Abelmann, S. Gorbarenko

08:30	High-arctic Holocene records of land-ocean interactions Bauch, H.A., Müller-Lupp, T., Polyakova, Ye.I., Röhl, U., Niessen, F.
08:45	Coastal processes and the sediment budget of the Laptev Sea Rachold, V., Are, F.E., Grigoriev, M.N., Hubberten, H.-W., Rasumov, S., Schneider, W., Schwamborn, G.
09:00	Ostracoda of the Laptev Sea: Holocene to recent Stepanova, A., Taldenkova, E., Bauch, H.A.
09:15	Holocene changes of riverine discharge and surface water salinity in the Laptev Sea inferred from diatom assemblages Polyakova, Ye.I., Bauch, H.A.
09:30	Modern and past records of shelf hydrography in the Laptev Sea Müller-Lupp, T., Bauch, H., Erlenkeuser, H.
09:45	Holocene environmental changes of the eastern Laptev Sea: evidence from fossil assemblages Taldenkova, E., Bauch, H.A., Stepanova, A., Dem'yankov, S.
10:00 - 10:30	Coffee break

Session 3: Records of land-ocean linkages (continued)
Conveners: H. Bauch, M. Grigoriev, A. Abelmann, S. Gorbarenko

10:30	Radiolarians in the Sea of Okhotsk - tracers for past hydrographic and biological conditions Abelmann, A., Matul, A., Nimmergut, A., Nürnberg, D., Tiedemann, R.
10:45	The polar planktic foraminifera *Neogloboquadrina pachyderma* (sinistral) in the Okhotsk Sea: carbon isotopes, habitat and the "Carbonate Ion Effect" under natural conditions Bauch, D., Erlenkeuser, H., Winckler, G., Pavlova, G., Thiede, J.
11:00	High-frequency surface environmental and sedimentary changes in the Okhotsk Sea during the Late Pleistocene: geochemical, paleontological and lithological evidence Gorbarenko, S., Leskov, V., Gvozdeva I.G., Bosin, A., Biebow, N., Tiedemann, R., Nuernberg, D.
11:15	Orbital to millenial-scale to century-scale paleoceanographic and paleoclimatic changes in the Sea of Okhotsk Nürnberg, D., Tiedemann, R., Kaiser, A., Kozdon, R., Lembke, L., Biebow, N., Roehl, U.
11:30	Bottom current-controlled sedimentation and mass wasting in the northwestern Sea of Okhotsk Wong, H.K., Lüdmann, T., Baranov, B.V., Karp, B.Ya., Konerding, P.
11:45 - 12:05	Poster presentation Session 3
12:05 - 12:45	Posters Session 2 and 3
12:45 - 13:45	Lunch

Session 4: Sea level, ice sheets and permafrost
Conveners: H.-W. Hubberten, L. Savatyugin, N. Romanovskii, D. Nürnberg

13:45	Environmental changes and catastrophic cold events after the last glacial extreme, Laptev Sea region Romanovskii, N., Gavrilov, A.V., Kholodov, A.L., Tumskoy, V.E.
14:00	Siberian permafrost as paleoenvironmental archive - new results and new perspectives Schirrmeister, L., Siegert, C., Hubberten, H.-W., Meyer, H., Kienast, F., Andreev, A., Grosse, G., Kunitsky, V., Dereviagin, A., Kuznetsova, T., Kuzmina, S., Bobrov, A.
14:15	Evidence from the Laptev Sea shelf for the transformation of a late glacial permafrost landscape into a marine depositional environment Bauch, H.A., Kassens, H., Müller-Lupp, T., Polyakova, Ye.I., Drachev, S., Meyer, H., Niessen, F.
14:30	Microbial controls on methane emission from Siberian tundra environments: open questions and future perspectives Wagner, D., Pfeiffer, E.-M., Samarkin, V.
14:45 - 15:15	Coffee break

Session 4: Sea level, ice sheets and permafrost (continued)
Conveners: H.-W. Hubberten, L. Savatyugin, N. Romanovskii, D. Nürnberg

15:15	724-meter deep ice core from Academy of Sciences ice cap (Severnaya Zemlya) - accumulation rate, preliminary time scaling and data resolution Fritzsche, D., Wilhelms, F., Pinglot, J.F., Meyer, H., Schütt, R., Weiler, K., Savatyugin, L.M., Miller, H., Hubberten, H.-W.
15:30	Paleoceanographic studies in the Sea of Okhotsk - Implications for the glaciation history of NE-Siberia Nürnberg, D., Kaiser, A., Tiedemann, R., Biebow, N.
15:45	LGM glaciation and Siberian River Runoff in the Kara Sea: results from the RV "Boris Petrov" expedition 2001 (SIRRO project) Niessen, F., Stein, R., Dittmers, K.
16:00	History of Eurasian ice sheets reflected in Arctic deep-sea sediments Spielhagen, R., Nørgaard-Pedersen, N., Erlenkeuser, H., Vogt, C., Weiel, D.
16:15 - 16:35	Poster presentation Session 4
16:35 - 17:00	Posters Session 3 and 4
17:00 - 18:30	Round table: Perspectives in Geosciences
18:30 – 22:00	Conference barbecue

Posters

Session 3

Are, F.E., Hubberten, H.-W., Rachold, V., Reimnitz, E., Solomon, S. Mathematical description of erosional shoreface profiles in the arctic seas

Artyomova, A.V., Gorbarenko, S.A., Leskov, V.Yu., Psheneva, O.Yu, Zhuravlenko, O.A., Biebow, N., Tiedemann, R. Late Pleistocene and Holocene paleoceanography of the Okhotsk Sea based on diatom, geochemical and lithological data

Bubenshchikova, N.V., Khusid, T.A., Iushina, I.G., Gorbarenko, S.A. Benthic foraminifera evidence of Late Quaternary oceanographic changes in the southwestern Okhotsk Sea

Dem'yankov, S., Taldenkova, E., Bauch, H.A. Foraminifers of the Laptev Sea shelf as indicators of paleoenvironmental changes

Grigoriev, M.N., Are, F.E., Hubberten, H.-W., Razumov, S.O. Coastal dynamics of the Lena Delta, the Laptev Sea, Siberia

Kokfelt, U., Tiedemann, R., Nürnberg, D., Kaiser, A., Kozdon, R., Biebow, N. Holocene vegetation change and Amur River run-off based on the analysis of pollen, spores and chloroccacalean algae in core LV28-4-4 from the Sea of Okhotsk

Kozdon, R., Tiedemann, R., Nürnberg, D., Kaiser, A., Kokfelt, U., Biebow, N. Röhl, U. A high resolution Holocene geochemical record from the Sea of Okhotsk - Implications for climate change in the Siberian hinterland

Mardanian, I. Kodina, L. Pecularities of organic carbon distribution in the Kara Sea sediments compared with the Laptev Sea

Matul, A., Abelmann, A. The radiolarian *Amphimelissa setosa* – a potential indicator for a North Pacific/North Atlantic link during marine isotopic stage 5

Naidina, O.D., Bauch, H.A. Holocene pollen records from the Laptev Sea

Nikolayeva, N.A., Derkachev, A.N., Gorbarenko, S.A. Sediment supply and distribution in the Sea of Okhotsk during the Late Quaternary (based on the analysis of heavy mineral associations)

Novichkova, T.S., Polyakova, Ye.I., Bauch, H.A. Detailed reconstructions of depositional environments and water salinity fluctuations on the eastern Laptev Sea shelf during the Early to Middle Holocene

Nürnberg, D., Tiedemann, R. Long-term environmental evolution in the Sea of Okhotsk - Evidence from a long IMAGES core

Nürnberg, D., Tiedemann, R., Kaiser, A., Kozdon, R., Lembke, L. Orbital to sub-orbital paleoceanographic and paleoclimatic changes in the Sea of Okhotsk

Psheneva, O.Yu., Gorbarenko, S.A., Artyomova, A.V., Leskov, V.Yu., Matul, A., Nürnberg, D., Biebow, N. Species and abundance changes of benthic foraminifera in core LV27-2-4 (far NW Okhotsk Sea)

Rudenko, O.V., Polyakova, Ye.I., Bauch, H.A. Postglacial environments on the eastern Laptev Sea shelf: evidence from diatom and aquatic palynomorphs assemblages

Schoster, F., Bourtman, M., Dittmers, K., Levitan, M., Niessen, F., Steinke, T., and Stein, R. Siberian River Run-Off: Transport pathways of terrigenous material from Ob and Yenisei rivers into the Kara-Sea

Tekleva, M.V., Kosenko, Ya.V., Naidina, O.D. Pollen in shelf sediments as indicator of climate change in Arctic Siberia

Session 4

Andreev, A.A., Schirrmeister, L., Siegert, Ch., Grosse, G., Novenko, E.Yu. Hubberten, H.-W. Environmental changes on the Laptev Sea coast during the Late Quaternary reflected in pollen records

Anisimov, M., Tumskoy, V.E. Environmental history of the Novosibirskiye Islands for the last 12 ka

Bolshiyanov, D.Yu., Fedorov, G.B., Savelieva, L.A. Climate changes in the Laptev Sea region in Holocene as inferred from data on the continental circumference

Drachev, S.S., Chizhov, D., Kaulio, V.V., Niessen, F., Tumskoi, V. Acoustic imaging of the submarine permafrost in the Laptev Sea

Fedorov, G.B., Bolshiyanov, D.Yu. Sea level and glaciations of Taymyr Peninsula in the Late Pleistocene

Grosse, G., Schirrmeister, L., Krbetschek, M., Schwamborn, G., Oezen, D., Kunitsky, V.V., Kuznetsova, T., Kuzmina, S. New data of late Quaternary terrestrial permafrost deposits of the Laptev Sea region by IR-OSL, radiocarbon and U/Th age determination

Kaiser, A., Nürnberg, D., Tiedemann, R. Glaciation history in NE Siberia - Implications from IRD and stable oxygen isotope records

Kholodov, A.L., Gavrilov, A.V., Romanovskii, N.N., Tipenko, G.S. Submarine permafrost on the Laptev Sea shelf: evolution during the Middle Pleistocene-Holocene and recent processes

Kobabe, S., Wagner, D., Kutzbach, L., Pfeiffer, E.-M. Methane production in Siberian tundra soils: influence of temperature and substrates

Leskov, V.Yu., Gorbarenko, S.A., Artemova, A.V., Biebow, N., Tiedemann, R., Nürnberg, D. Sea-ice change in the Okhotsk Sea and its paleoceanographical consequences during Last Glaciation-Holocene; evidence from ice rafted debris and diatom

Meyer, H., Dereviagin, A.Yu., Siegert, C., Hubberten, H.-W. Stable water isotopes of ice wedges as paleoclimate indicator for the Laptev Sea region, Northern Siberia

Müller-Lupp, W., Möller, R., Bölter, M. Temperature as a regulation force for gas evolution

Roudoy, A.S., Tverskaja, L.A., Roschina, D.V. On the importance of foraminifera of the genus Retroelphidium for paleogeographic and paleofacies reconstruction

Spieck, E., Lebedeva, E., Jozsa, P.-G. Occurrence of nitrifying bacteria in permafrost sediments

Tumskoy, V.E., Romanovskii, N.N., Gavrilov, A.V. Thermokarst formation at the end of the Late Pleistocene and Holocene and its impact on the permafrost of the eastern part of the Russian Arctic

Vanshtein, B.G., Cherkashev, G.A., Krinitzky, P.I., Firsov, Yu.G., Volkova, Yu.V., Mirolubova, E.S. Geological environment changes of Western Russia coastal zone by climate warming

Saturday, May 11, 2002

Session 5: High-resolution environmental archives
Conveners: J. Negendank, H. Oberhänsli, N. Dobrezov, A. Sher

09:00	Maar lake sediments: time-, environment and climate indicators Negendank, J.F.W. & Team
09:15	The Late Quaternary climatic and environmental history of northern Central Siberia - Evidence from lake sediments Hubberten, H.-W., Andreev, A., Kumke, T., Melles, M., Schwamborn, G., Siegert, C. Tarasov, P.
09:30	High-resolution continental paleoclimatic records from Lake Baikal sedimentary cores Bezrukova, E.V., Kuzmin, M.I., Kawai, T., Williams, D.F., Karabanov, E.B., Prokopenko, A.A., Bychinskyi, V.A., Geletyi, V.F., Kerber, E.B., Khomoutova, M.Yu.
09:45	Pleistocene climate drivers of the East Siberian shelf land Sher, A., Kuzmina, S., Kuznetsova, T.
10:00 - 10:30	Coffee break

Session 5: High-resolution environmental archives (continued)
Conveners: J. Negendank, H. Oberhänsli, N. Dobrezov, A. Sher

10:30	Pleistocene-Holocene High-Resolution Continental Records from the Lake Baikal: Timing and Connection to Climate of North Atlantic E. Karabanov, M. Kuzmin[2], D. Williams, E. Bezrukova, G. Khursevich, A. Prokopenko, S. Fedenia, S. Krapivina, A. Gvozdkov, the Lake Baikal Drilling Project Team
10:45	Dynamics of vegetation and peat accumulation in the west Siberian plain during the Holocene Velichko, A.A., Bleuten, W., Borisova, O.K., Kremenetsky, K.V., Novenko, E.Yu., Pisareva, V.V., Zelikson, E.M.
11:00	The maars and their paleoclimatic records in China - A maar drilling program for Chinese-German cooperation Liu, J., Negendank, J.F.W., Chu, G., Mingram, J., Wang, W., Liu, Q., Gu, Z., Ni, Y., Liu, T.
11:15	Continuous loess record of the last 5 million years An Zisheng
11:30	El´gygytgyn Lake, NE Russia: a millennial-scale record of climate evolution in the Arctic over the past 3.6 million years Melles, M., Niessen, F., Hubberten, H.-W., Nowaczyk, N.R., Minyuk, P., Brigham-Grette, J.
11:45	Holocene multidecadal to centennial climate variability in the Sea of Okhotsk Tiedemann, R., Nürnberg, D., Kozdon, R., Lembke, L., Kaiser, A., Kokfelt, U.
12:00 - 12:20	Poster presentation Session 5
12:20 - 12:45	Posters Session 5 and 6
12:45 - 13:45	Lunch

Session 6: Geodynamic evolution of the Eurasian block
Conveners: H. Echtler, C. Gädicke, G. Grikurov, B. Baranov

14:00	Plate kinematic imprint on the structural pattern of the northeastern Eurasian marginal seas Baranov, B.V., Karp, B.Ya., Wong, H.K.
14:15	Rift to drift transition in the Laptev Sea: geodynamics and environmental impact Drachev, S.S., Belyaev, V.N., Goryachev, Yu.V., Kaul, N., McAdoo, D., Niessen, F., Antipov, A.A.
14:30	Geodynamic evolution of the Kurile-Kamchatka Island Arc system and variation of magma generation conditions Avdeiko, G.P., Hoernle, K., Portnyagin, M., Ponomarev, G.P., Pilipchuk, N.A., Uspensky, V.S., Sachs, P.
14:45	The role of deep fluids in magma generation in the Kurile-Kamchatka Arc: an overview of goals, approaches and recent results of KOMEX Subproject 2 Portnyagin, M., Hoernle, K., Avdeiko, G., Mironov, N., Sachs, P., Werner, R.
15:00 - 15:30	Coffee break
15:30 - 15:50	Poster presentation Session 6
15:50 - 16:30	Posters Session 5 and 6
16:30 – 16:50	Sea level and climate: listen to tropical corals what they can tell Dullo, W-Chr.
17:00 – 17:30	Panel discussion

Posters

Session 5

Bolshiyanov, D.Yu., Sviyashennikov, P.N., Fedorov, G.B., Pavlov, M.V., Terebenko, A.V. Arctic climate changes during the last 10,000 years

Brauer, A., Litt, T., Negendank, J.F.W. Nature and rapidity of Late Glacial changes in the varved lake record of Meerfelder Maar, Germany

Brauer, A., Negendank, J.F.W., ELDP Consortium. Advances in correlation of European high-resolution palaeoclimatic records

Brauer, A., Brathauer, U., Prasad, S., Litt, T., Negendank, J.F.W. Pleistocene maar lakes in the Eifel – varved lacustrine sediments – a high-resolution archives for environment changes and climate variability

Goldberg, E.L., Grachev, M.A., Phedorin, M.A., Chebykin, E.P., Khlystov, O.M., Vorobyeva, S.S., Zheleznykova, T.O., Kulipanov, G.N., Kondratev, V.I., Zolotarev, K.V., Tsukanov, V.M., Miginsky, E.G., Shaporenko, A. Multi proxy high-resolution paleoclimate records from Lake Baikal: orbital forcing during the last million years and millenial-scale climate changes during Holocene and LGP

Kremenetski, K.V., MacDonald, G.M., Gervais, B., Bottger, T., Hiller, A., Borisova, O.K., Snyder, J.A. Postglacial climate and vegetation history of Kola Peninsula, Russia

Kuzmina, S., Sher, A., Demyankov, S. Detailed reconstruction of the Laptev shelf land environment and climate during the last 50,000 years - Mamontovy Khayata revisited

Kuznetsova, T.V., Kuz'mina, S.A. Pleistocene and Holocene mammals, insects and deposits of the Lena Delta region (Olenyok Channel)

Migowski, C., Negendank, J.F.W., Stein, M. Holocene palaeoseismic and climatic record in laminated sediments from the Dead Sea, Israel

Migowski, C., Prasad, S., Negendank, J.F.W., Stein, M. Pleistocene-Holocene sediments from Lake Lisan and Dead Sea

Mingram, J., Schettler, G., Nowaczyk, N., Luo, X., Lu, H., Yancheva, G., Jiaqi, L., Negendank, J.F.W. A 78,000 year record of climatic changes from the South China coast – Huguang maar lake (Huguangyan)

Negendank, J.F.W., Brauer, A., ELDP Members (European Lake Drilling Programme) Advances in correlation of European high-resolution palaeoclimatic records

Negendank, J.F.W., Schwalb, A., Schwab, M., the KIHZ Consortium. KIHZ I. KIHZ - Natural climate variations: overview and climate archives

Oberhänsli, H. Centennial resolution in the Baikal archive

Pavlov, M.V., Razina, V.V., Bolshiyanov, D.Yu. The last millenium climate changes and reconstruction of the Little Ice Age time by the bottom sediments of the arctic lakes

Ramrath, A., Nowaczyk, N.R., Wulf, S., Negendank, J.F.W. A high-resolution 14,000-year record from Lago di Mezzano, Central Italy – palaeoenvironmental changes and human impact

Razina, V.V., Pavlov, M.V., Bolshiyanov, D.Yu. Reconstruction of vegetation and climate situation in the Norilsk Lakes region, Putorana Plateau, for the last millenium according to pollen data

Schettler, G., Rein, B., Negendank, J.F.W. Geochemical evidence for Holocene palaeodrainage variations from a lacustrine record, Lake Schalkenmehrener Maar, Westeifel Volcanic Field, Germany

Schettler, G. Laghi di Monticchio – a geochemical study of the surface sediments

Schettler, G., Romer, R.L., O'Connell, M. Anthropogenic airborne lead in sediments from An Loch Mór, Inis Oírr, W. Ireland – new insights into atmospheric lead pollution in Europe during the Roman period

Schettler, G., Negendank, J.F.W. Annual laminated lake records and their different geochemical responses to palaeoenvironmental variations during the last 13 ka (Meerfelder Maar, Schalkenmehrener Maar, Holzmaar; Westeifel, Germany)

Schettler, G., Mingram, J., Negendank, J.F.W., Jiaqi, L. Atmospheric lead-210 flux variations for north-eastern China during the last 200 years

Schwab, M., Negendank, J.F.W., KIHZ Consortium. KIHZ III. The high resolution multi-proxy-parameter network and synthetic timescale in KIHZ (Natural Climate Variations in the Holocene)

Schwab, M., Frank, U., Brüchmann, C., Kulbe, T., Neumann, F., Stebich, M., Nowaczyk, N.R., Acksel, D., Negendank, J.F.W. Neue Maar-Sedimentkerne als Klimaarchiv für das Holozän – Lac Pavin (Massif Central) und Birkat Ram (Golan-Hights)

Sher, A., Gukov, A., Sofronov, Yu., Kuzmina, S., Sulerzhitsky, L. Moose and tall shrubs: new evidence on the Early Holocene climatic optimum in the Lena Delta

Tarasov, P.E. Holocene climate and environmental changes in the Great Steppe of Eurasia

Vaganov, E.A. High resolution records of temperature change during the last millenia in high latitudes of Siberia

Widmann, M., von Storch, H., the KIHZ Consortium. II. KIHZ - Numerical modelling in paleoclimatology

Wulf, S., Brauer, A., Frank, U., Mingram, J., Nowaczyk, N., Zolitschka, B., Negendank, J.F.W. The Lago Grande di Monticchio (Italy) – a high-resolution archive for palaeoenvironmental and tephrostratigraphical investigations of the last 101 ka

Session 6

Baranov, B., Werner, R., Hoernle, K., Tsoy, I.B., van den Bogaard, P., Tararin, I.A. Evidence for compressionally-induced high subsidence rates in the Kurile Basin (Okhotsk Sea)

Chernyh, A.A., Zayonchek, A.V., Gusev, E.A., Mennies, M.V., Romaschenko, E.G., Razouvaeva, E.I. New digital bathymetry map of the Laptev Sea

Dozorova, K.A., Baranov, B.V., Wong, H.K., Karp, B.Ya., Karnaukh, V.N., Lüdmann, T. Geological factors controlling the morphology of the East Sakhalin slope

Gramberg, I.S., Piskarev, A.L. Structure and crustal history of the Laptev Basin

Gusev, E.A., Mennies, M.V., Rekant, P.V., Roudoy, A.S., Rybakov, K.S. Termination of the Gakkel Ridge in the Laptev Sea

Gusev, E.A., Mennies, M.V., Romaschenko, O.G. Morphology of the continental margin of the Laptev and East Siberian seas

Gusev, E.A., Rekant, P.V., Roudoy, A.S. Paleogeographic changes in deep-sea arctic basins as indicators of the main stages of the Cenozoic evolution

Karp, B., Karnaukh, V., Baranov, B.V., Lüdmann, T., Wong, H.K. Interaction between Cenozoic sedimentation processes and tectonics in the Okhotsk Sea: results of the KOMEX expeditions

Piskarev, A.L. Potential field anomalies interpretation in the Eurasian Basin of the Arctic Ocean

Rekant, P.V. Pleistocene sedimentation and sediment transport on the Laptev Sea shelf and continental slope

Zayonchek, A.V., Chernyh, A.A. Transition from the Gakkel Ridge to the Laptev Sea shelf

Abstracts

RADIOLARIANS IN THE SEA OF OKHOTSK - TRACERS FOR PAST HYDROGRAPHIC AND BIOLOGICAL CONDITIONS

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The Sea of Okhotsk (SOk) represents a key area for environmental and paleoceanographic investigations because of the unique climatic situation with sea-ice cover during winter and a relatively strong warming of the surface waters during summer that lead to a specific hydrography and to the deposition of radiolarian assemblages, which may represent a potential analogue for past glacial conditions in both, northern and southern high latitude oceans. Beyond that, the SOk is supposed to be an important source area of North Pacific intermediate water, and thus the reconstruction of the paleoceanographic conditions in the SOk might give further information needed for the understanding of the paleo-ocean circulation and chemistry of the North Pacific.

In the frame of the German/Russian cooperation KOMEX (Kurile - Okhotsk Sea Marine Experiment), we studied the spatial distribution pattern of radiolarians in the upper 1000 m of the water column in the SOk and compared these data to surface sediment and down-core data.

We discuss various aspects of the significance of the radiolarian signal for paleoenvironmental and paleoceanographic reconstructions in the SOk with specific emphasis on the changes of the paleohydrographic pattern and productivity regime.

DIEL VERTICAL MIGRATIONS OF MESOZOOPLANKTON IN THE LAPTEV SEA INFERRED FROM ACOUSTIC BACKSCATTER SIGNAL: LONG- AND SHORT-TERM VARIATIONS

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Diel vertical migration (DVM) is observed in many zooplankton taxa. Normal DVM is a pattern of migrating to deeper water during the daylight hours and rising to surface waters at night.

In the arctic marginal seas, the degree of illumination does not considerably change during polar day or polar night. Due to the geographical location of the Laptev Sea (72° to 82°N), the duration of the polar day and polar night at 74°N is 102 and 85 days, respectively, while at 82°N it is 149 and 133 days. The peculiarities of the DVM of zooplankton in the arctic seas (Laptev Sea as an example) are discussed on the basis of daily layer-by-layer catches and daily and yearly ADCP (Acoustic Doppler Current Profiler) records.

Zooplankton samples and ADCP data, obtained during the Russian-German TRANSDRIFT VI and VIII expeditions (Apr.-May 1999, Aug.-Sept. 2000) and zooplankton samples from the Russian-American MERA-95 expedition (Aug.-Sept. 1995), were used to analyze the vertical distribution of zooplankton.

Towards the end of the summer season, when the day-and-night cycle is already well pronounced, the daily backscatter intensity and daily vertical distribution of total zooplankton abundance reveal similarly strong diurnal variations. The vertical distribution of different age stages of some Copepoda species dominating the pelagic fauna of the Laptev Sea shelf shows a permanently high abundance of young stages in the surface layer. Young Copepoda stages cannot swim fast enough to keep up with the diel migration of the target isolume. The adult stages show normal DVM, and their abundance increases in the upper layer at night and decreases during daytime. The diurnal changes of echo-intensity demonstrates this process rather well.

ADCP records from two oceanographic bottom stations „YANA“ (75°09'N, 44 m) and „LENA“ (73°27'N, 22 m), deployed on the Laptev Sea shelf from August 1998 until August 1999, were used for understanding the seasonal variations in the vertical distribution of pelagic species. During a complete annual cycle, two periods with enhanced DVM of zooplankton and with strong diurnal variations are recognized (February-May and August-November) as well with the help of a pronounced acoustic backscatter signal. These periods generally correspond to times with well established day-and-night cycles and slightly extend into the end/beginning of polar day and polar night. Thus, our results confirm the leading role of light in initiating DVM.

ZOOPLANKTON ABUNDANCE, BIOMASS AND PRODUCTION IN THE LENA DELTA POLYGON LAKES: PRELIMINARY RESULTS

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Small thermokarst lakes are the most abundant type of water bodies in the higher latitude areas. The annual primary production in these tundra lakes is known to be low, but this is largely due to the short ice-free season. The daily primary production in these types of lakes is rather high. Polygonal tundra occupies about 1/3 (9,600 km^2) of the total Lena Delta area, and small thermokarst lakes play a significant role in the delta ecosystem. The main tasks of our investigation are to study zooplankton species composition and the seasonal dynamics of zooplankton abundance and biomass and to estimate the daily zooplankton production in the polygon lakes of the Lena Delta.

Samples were obtained from two localities in the Lena Delta, Tit-Ary and Samoylov Islands, in the summer 2000 and 2001 with 3-5 days' interval. The abundance of every species and its stages were calculated in the Bogorov chamber. The individual weights of organisms were identified using the formula of body weight-length dependence. The production of the populations was estimated through the daily biomass growth. The relative duration of the different age stages development was either estimated experimentally or taken from relevant publications. The daily production of each age-size stages of the most common species was calculated separately. The total daily production of a population was calculated as the sum of different age groups' productions.

The species diversity of zooplankton in the polygon lakes is not high, about 30 species were identified. The most important groups in terms of production are: Copepoda (11 species), Cladocera (4) and Phyllopoda (3). Species of Rotatoria (14 species) are always present in the pelagic association but they do not play an essential role because of their small size and comparatively low biomass.

Zooplankton abundance, biomass and daily production are very changeable in the polygon lakes and depend upon the life cycle of the 3-5 dominant species and, also, temperature conditions. During summer, the total abundance is changing from 2,000 to 90,000 ind./m^3 and the total biomass from 0,1 to 12 g/m^3. The average zooplankton abundance for the whole period of investigation during summer 2000 was 24,000 ind./m^3 and the biomass 1.5 g/m^3 while during summer 2001 it was 19,000 ind./m^3 and 2.5 g/m^3, respectively. The daily production of Calanoida species, like *Diaptomus sp*. and *Heterocope borealis* comprised about 80% of the total zooplankton abundance ranging from 0.21 mg/l (July) to 4.18 mg/l (August). The daily production of Cladocera species *Daphnia pulex* and *Chydorus sphaericus* was higher and varied from 4.3 mg/l (the end of June) to 5.3 mg/l (July). Preliminary data suggest that, compared to other tundra water basins, zooplankton abundance, biomass and secondary daily production in the small thermokarst lakes are rather high.

USAGE OF BATHYMETRIC MAPS AND MODERN REMOTE SENSING TECHNOLOGIES IN INVESTIGATIONS OF POLAR SEAS

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Numerous programs of modern investigations of World Ocean require an appropriate map provision.

While designing any researches in marine areas we should by all means make use of sea maps.

Map-making of the sea-bed relief of the World Ocean is being developed in two basic lines: composing navigatory sea maps (NSM), used in navigating, and bathymetric maps (BM) intended for the general study of a particular marine area, understanding the regularities of underwater relief formation, using them as the basis in composing topic maps.

Bathymetric maps deserve special emphasis while being used as the basis for registering data, obtained by distant sounding.

Under the rather severe polar conditions the use of ships, sea-shore stations or even airplanes for carrying out necessary observations, as a rule, is little effective or impossible due to the vast and remote territories concerned and due to the need of repeated surveys.

Distant sounding from artificial satelites of the earth, placed at the polar orbits could be the only practical solution in the case.

ENVIRONMENTAL CHANGES ON THE LAPTEV SEA COAST DURING THE LATE QUATERNARY REFLECTED IN POLLEN RECORDS

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Pollen, ^{14}C, and U/Th data from the Lena River Delta (Buor-Khaya), Bykovsky Peninsula and Bol'shoy Lyakhovsky Island document the environmental history in the region during the last 200 k.y. Rich grass-sedge tundra dominated about 200 U/Th k.y. BP on Lyakhovsky Island. The absence of typical cryoxerophitic taxa, high pollen concentration, and low amounts of redeposited pollen indicates a relatively warm and wet climate. This interval may correspond with an interstadial at the end of Tazovsky (Saale) stadial.

Large amounts of redeposited palynomorphs and the presence of cryoxerophitic taxa characterize all pollen records dated >55-50 ^{14}C k.y. BP. Dry grass and sedge communities with few other herbs dominated the vegetation.

Mostly sedge and grass tundra-like vegetation with some other herbs dominated ca. 50-48 k.y. BP in all localities. The climate was rather cold but relatively wet during this interval, corresponding to the beginning of the Karga (Middle Weichselian) Interstadial.

Sedge and grass tundra communities with Caryophyllaceae and Compositae dominated at Bykovsky and Buor-Khaya sites ca. 48-32 k.y. BP. Relatively high *Artemisia* pollen contents reflect steppe associations. The presence of warmth indicators (*Salix*, *Betula nana*, Ericales pollen) reflects a relatively warm and wet climate during the Middle Karga.

After ca. 30 k.y. BP the sedge pollen content decreased in the spectra, while Poaceae, Cichoriaceae, and *Selaginella rupestris* increased. Grass communities with some Asteraceae, *Artemisia*, Cichoriaceae and *Selaginella* dominated during the LGM. Large amounts of redeposited pollen reflect a scarce vegetation cover and/or low pollen productivity in that time. Climate was much dryer and colder than during the previous intervals.

Increase of sedge and Ericales pollen contents ca 15-13 k.y. BP in Bykovsky spectra may reflect wetter and warmer climate conditions during that time. Relatively high amounts of *Encalypta* (moss growing on disturbed soils) spores are also noticeable in these samples.

An increase of pollen concentration and presence of *Salix* and *Betula nana* pollen, reflecting an amelioration of climate, is characteristic of sediments dated to the Allerød in the Lyakhovsky records. The decrease of pollen concentration and the disappearance of shrub pollen are noticeable for Younger Dryas spectra and records a climate deterioration.

The Late Glacial/Holocene transition is noticeable in all sites by the appearance of tree, shrub, and Ericales pollen and spores of *Sphagnum*. The highest pollen concentration and shrub pollen content in the deposits, dated from 9 to 4,5 k.y. BP, reflects that the climate was most favorable during that interval. The decrease of amounts of tree pollen reflects the deterioration of climate at the end of the Subboreal period, ca 2,5 k.y. BP. Climate and vegetation became similar to the modern one after that time.

A high concentration of alga colonies (*Pediastrum* and *Botryococcus*) in many Ice Complex samples from Bykovsky Peninsula shows that sedimentation took often place in a shallow-water environment (centers of polygons?). The concentration of alga colonies is significantly lower in Bol'shoy Lyakhovsky Island and Buor-Khaya deposits, probably reflecting dryer conditions there, although they are also represented in many samples. Their permanent presence reflects the probably subaquatic character of the investigated Ice Complex sediments.

ENVIRONMENTAL HISTORY OF THE NOVOSIBIRSKIYE ISLANDS FOR THE LAST 12 KA

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The presented materials generalize paleo-geographical studies of Kotelny and Zhokhov islands (Makeev et al., 1989, 1999) and Bennetta Island (Verkulich et al., 1989, 1995) and fieldwork of different years performed by the authors on Bennetta, Zhokhov, Bol'shoy Lyakhovsky and Novaya Sibir' islands.

The New Siberian Islands are located on the continental shelf presenting fragments of an extensive plain that existed during the period of the last (Sartanian) cooling. The sea level at that time was 100-120 m lower than the modern one, which determined the coastline location of 700-1000 km to the north compared to the current one.

No thick ice sheet glaciers similar to those in Scandinavia or North America existed in the region of the New Siberian Islands. Numerous ^{14}C datings in the range 24-17 ka confirm this. Small passive ice sheets were only located on the northern islands of the archipelago. Their fragments are still preserved on Bennetta, Genrietta and Zhannetta Islands. Unclear traces of the car-near-slope glaciers in the form of unpronounced ice deposits are preserved on Zhokhov Island. Over much of the territory, deposits of various genetic types with high ice content accumulated, whose typical feature was the presence of big ice wedges (Ice-Complex deposits). The thickness of the deposits increased southward from 5-10 m to 50-70 m.

As a result of a series of warming events at the end of the Late Pleistocene and of the decay of ice sheet glaciers in the north of Europe and America, the sea level rise began in the eastern Arctic with the coastline advancing southward. According to the results of studies in the Laptev Sea region, the sea level rise began around 17 kyr BP achieving its current position around 5 kyr BP. The coastline, however, was located much more to the north than at present. Thus, rocks with high ice content were not yet destroyed by thermal abrasion. The marine transgression reached its maximum around 4 kyr BP. The sea level at this time was 3-4 m higher than the current one whereas the coastline was tens and hundreds of kilometers from its present position. Due to the fact that the overwhelming part of the shore was comprised of deposits with high ice contents, the terrace levels, formed at this time, were destroyed due to thermal abrasion and were preserved only on some segments of bedrock outcrops. For examples, there are radiocarbon datings of driftwood from a laida (with a height of 4-5 m) in the northern part of Zhokhov Island (4.9-3.9 kyr BP). Insignificant climate coolings in the Holocene resulted in slower rates of sea transgression or in some regressions. Due to this, probably around 9 kyr BP, a terrace level at the depth of about 15 m (Zhokhov Island) was formed. The presence of a large quantity of the driftwood fragments at the monument (Zhokhov Island) and the features of depth distribution around Zhokhov Island provide indirect evidence of this. We have recorded one more insignificant sea level rise on Stolbovoy Island. A band of driftwood concentration found at the distance of 60-70 m from the shore at a height of about 3 m above the sea level was dated. The radiocarbon age of the wood is 1255±40 kyr BP (LE-5850). There was a short-term warming at this time and it is also probable that the driftwood band was formed due to strong storms in the ice-free sea.

During the warming periods of the end of the Late Pleistocene (Raunis, Bölling and Alleröd climatic stages) the area of the New Siberian Islands still presented one continental land, which is indicated by dating of the mammoth tusk from Bennetta Island (12.5 kyr BP).

The decrease of climate continentality and increased humidity at the end of the Late Pleistocene resulted in a sharp intensification of thermokarst processes. The accumulation of deposits with high ice content on land was replaced by their melting. On Novaya Sibir' Island, a horizontally bedding organic interlayer with an age of 11050±60 (GIN-11246) overlaps a cast along the ice wedges. On Novaya Sibir Island, there is also a date of 10750±100 years BP (GIN-11247) obtained from an interlayer of allchthonous peat filling a thermokarst basin. Intensification of solifluction and thermal erosion belongs approximately to this time. There are similar datings from Bol'shoy Lyakhovsky Island.

The formation of peat bogs began synchronously in series with the development of thermokarst depressions. On Kotelny Island, they are dated as beginning at 12.3 kyr BP (LU-1763) and on Zhokhov Island at 12.2 kyr BP. Milder temperature conditions resulted in the vegetation boundary advancing northward. In peat bogs on Zhokhov, Kotelny, Novaya Sibir' and Bol'shoy Lyahkovsky islands, numerous remnants of shrubs growing here in the Holocene were encountered. A decrease in intensity of the mass thermokarst development belongs to the middle of the Holocene. Around 3 kyr BP, the accumulation of peat bogs ends (3380±40, LE-5854 – peat bog on Novaya Sibir' Island).

The presence of human beings on Zhokhov Island belongs to the Holocene optimum (around 8 kyr BP). Due to bathymetry features near Zhokhov Island, the distance from the site of ancient people to the seashore was not greater than several kilometers. A large quantity of driftwood remains and bone remnants of a sea animal at the ancient site of the presence of human beings serve as indirect evidence.

The available data on the Novosibirskiye Islands indicate synchronous climatic changes in the territory of the eastern Arctic shelf. These changes were of a complicated rhythmic character determined not only by temperature fluctuations, but also by the climate changing from continental to marine due to sea transgression.

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MATHEMATICAL DESCRIPTION OF EROSIONAL SHOREFACE PROFILES IN THE ARCTIC SEAS

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A mathematical expression of shoreface profile is central to many coastal dynamics problems, such as shore displacement forecast, sediment transport etc. The first field investigations of the Laptev Sea shoreface shape along the erosional shores composed of unconsolidated sediments were carried out within the framework of the German-Russian bilateral project “Laptev Sea System 2000”. It was found that in the Laptev Sea, as well as in other shallow seas, the position of the shoreface lower boundary is determined by water depth. In most cases this boundary may be easily recognized by a pronounced order of

magnitude decrease in the mean inclination of the seabed. All retreating shoreface profiles off coasts composed of unconsolidated sediments have a concave shape. The shoreface inclinations depend on particle size and ice content of sediments composing the coast. In general the inclinations increase with increasing grain size and reduction of ice content. The mean shoreface inclination ranges from 0.0022 to 0.033. The shoreface profile shape off the retreating shores did not change much over the last 20-30 years, thus suggesting continuous retreat.

The assessment of the impact of permafrost, sea ice and other cryogenic factors is of basic importance for understanding of the arctic shoreface evolution. To this effect, the Arctic shoreface profiles in the Laptev and Canadian Beaufort seas were compared with well-studied profiles outside of the permafrost zone.

According to Bruun (1954) and Dean (1977, 1991) the shoreface profile of erosional sandy shores is best approximated using a power function: $h = Ax^m$. Here h is the water depth, and x is the distance from the shore. The coefficient A represents a sediment scale parameter which depends on sediment grain size, and m is a profile shape factor, reflecting the wave energy dissipation on the shoreface. According to Bruun and Dean the m value should equal 0.67, and the A value is in the range 0.06-0.2 for sandy shores. Bodge (1992) derived an exponential relationship $h = B(1 - e^{-kx})$, which, he suggests, fits the shoreface profile shape better than the power function. Bodge indicates that B is related to the closure depth and k reflects the sediment grain size. In this study, power and exponential fit curves were calculated for 6 shoreface profiles from the Laptev Sea and 16 profiles from the Canadian Beaufort Sea. A and m values ranged from 0.002 -1.38 $m^{1/3}$ and 0.19-0.89 respectively, with averages of 0.39 $m^{1/3}$ and 0.46. The average value of the coefficient of determination R^2 for the power relationship was considerably higher than for the exponential relationship (0.942 > 0.883).

Dean (1987) and Kriebel, Kraus, and Larson (1991) suggested empirical relations between A and sandy sediment grain size. We used them for 4 shoreface profiles from the Laptev Sea. Large divergences between fit curve parameters and calculated values were obtained.

On the whole, the preliminary mathematical analyses of the arctic shoreface profiles carried out in this study did not suggest an impact of cryogenic factors on their shape. However, the inability to use published empirical values of A as a function of grain size may be an indication that high latitude profiles are different in some fundamental way. Further exploration of the detailed profiles is required.

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LATE PLEISTOCENE AND HOLOCENE PALEOCEANOGRAPHY OF THE OKHOTSK SEA BASED ON DIATOM, GEOCHEMICAL AND LITHOLOGICAL DATA

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Investigations on diatoms were carried out on Okhotsk Sea cores GE 99-10, LV28-41 and L27-2-4. The sediment stratigraphy and age model of the cores is based on oxygen-isotope records, lithostratigraphy, magnetic susceptibility, tephrochronology and carbonate and opal stratigraphy. In order to reconstruct the paleoceanographic conditions, data of ice rafted debris (IRD) and radiolarian and foraminiferal analyses was used, as well.

Variations in diatom distribution, species diversity, diatom number per gram of dry sediment and in the temperature coefficient Td were studied. By comparing the geochemical and diatom data sets in two cores, 6 isotope-oxygen stages (IOS) and diatom complexes reflecting the main climatic and environmental changes in the Okhotsk Sea were distinguished. The diatom analysis also manifests a high-frequency change of the paleo-environment which corresponds to the changes in IRD number, $\delta^{18}O$ and other geochemical and paleontological parameters.

GEODYNAMIC EVOLUTION OF THE KURILE-KAMCHATKA ISLAND ARC SYSTEM AND VARIATION OF MAGMA GENERATION CONDITIONS

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The Kurile-Kamchatka Island Arc System represents a very appropriate region for studying the process of magma generation and determining the role of fluids in this process: there are two different-age volcanic arcs divided into several segments having various geodynamic conditions of magma formation. Three Kurile segments and the South-Kamchatka one are characterized by a steady-state regime of subduction beginning from Late Oligocene and by volcanic rocks of the island-arc (IA) geochemical type. The East-Kamchatka segment characterizes the initial stage of subduction. Here, alongside with the typical IA lavas, volcanic rocks of the intraplate geochemical type corresponding to the age of the beginning of subduction (Late Miocene) occur. The volcanic arc of the Sredinny Ridge is at the final stage of subduction, and here lavas of the intraplate type are also spread; they are almost of the same age as the intraplate ones of Eastern Kamchatka. Besides, the present-day intraplate lavas are found in the zone of junction between the Kamchatkan and Aleutian IA.

The working hypothesis (Avdeiko et al., 1999; 2001) suggests formation of the intraplate volcanic rocks due to partial melting of the subducted slab at temperatures higher than at the steady-state regime of subduction, either at the front of the subducted slab during the initial stage of subduction (Eastern Kamchatka), or as a result of intrusion of the hot under-subduction mantle into the rupture gaps of the subducted Pacific Plate at the final stage of subduction (Sredinny Ridge) and in the zone of junction between the Kamchatkan and Aleutian Arcs.

During 2001 field works within the KOMEX II project in order to test the working hypothesis, volcanic rocks were sampled for geochemical and isotopic analyses and for determining the age of the intraplate lavas from the majority of the key regions, where a coexistence of the typical island-arc and intraplate lavas was observed.

PLATE KINEMATIC IMPRINT ON THE STRUCTURAL PATTERN OF THE NORTHEASTERN EURASIAN MARGINAL SEAS

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Structural and magnetic data shows that in the Komandorsky Basin (western Bering Sea), the spreading axis strikes in NNE direction, while magnetic data in the Japan Sea demonstrates that the spreading axis is oriented nearly E-W.

In the Kurile Basin (Okhotsk Sea), magnetic data that could allows us to determine the strike of the spreading axis directly are lacking. However, a study of the NNW-SSE-striking basement rise located in its central part carried out in the framework of German-Russian KOMEX project shows that the rise morphology has the distinct imprint of a rift structure with symmetrical volcanic edifices on the rise axis and faulted blocks which tilt in opposite directions on the flanks. Such a structural pattern suggests that the opening axis of the Kurile Basin trends NW-SE. Thus, the spreading in the back-arc basins of the northeastern Eurasian marginal seas is parallel to the corresponding island arcs. The model of secondary convection in the back-arc area or the trench roll back model cannot explain such a mode of opening. A plate kinematic model based on strike-slip motion along the corresponding shear zones (Aleutian, Sakhalin and South-Okhotsk) seems to be the most applicable for this region.

EVIDENCE FOR COMPRESSIONALLY-INDUCED HIGH SUBSIDENCE RATES IN THE KURILE BASIN (OKHOTSK SEA)

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A combined volcanological, geochemical, paleoceanological, geochronological and geophysical study was undertaken in the Kurile Basin in order to constrain the origin and evolution of this basin. Very high rates of subsidence were determined for the northeastern floor and margin of the Kurile Basin. Dredged volcanic samples from the Geophysicist Seamount, which were formed under subaerial or shallow water conditions but are presently located at depths in excess of 2300 m, were dated at 0.84 ± 0.06 Ma and 1.07 ± 0.04 Ma with the laser $^{40}Ar/^{39}Ar$ single crystal method, yielding a minimum average subsidence rate of 1.6 mm/a for the northeast basin floor in Quaternary. Trace element and Sr-Nd-Pb isotope data from the volcanic rocks shows evidence for contamination within lower continental crust and/or the subcontinental lithospheric mantle, indicating that the basement presently at ~6 km depth is likely to represent thinned continental crust. Average subsidence rates of 0.5-2.0 mm/a were estimated for the northeastern slope of the Kurile Basin during Pliocene and Quaternary by the determination of the age and paleo-environment (depth) of the formation of sediments from a canyon wall. Taken together, the data from the northeastern part of the Kurile Basin indicates that the subsidence began in or prior to Early Pliocene and that subsidence rates have increased in Quaternary. Similar rates of subsidence have been obtained from published studies on the Sakhalin shelf and slope and from volcanoes in the rear of the Kurile Arc. The recent stress field of the Kurile Basin is inferred from the analysis of seismic activity, focal mechanism solutions and from the structure of the sedimentary cover and of the Alaid back-arc volcano. The integration of these results suggests that compression is responsible for the rapid subsidence of the Kurile Basin and that subsidence may be an important step in the transition from the formation of the basin to its destruction. The compression of the Kurile Basin results from squeezing of the Okhotsk Plate between four major plates: the Pacific, North American, Eurasian and Amur.

We predict that continued compression could lead to subduction of the Kurile Basin floor beneath Hokkaido and the Kurile Arc in the future and thus to basin closure.

THE POLAR PLANKTIC FORAMINIFERA *NEOGLOBOQUADRINA PACHYDERMA* (SINISTRAL) IN THE OKHOTSK SEA: CARBON ISOTOPES, HABITAT AND THE "CARBONATE ION EFFECT" UNDER NATURAL CONDITIONS

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The upper 500 or 1000 m of the water column in the Okhotsk Sea were sampled for living planktic foraminifera. The polar species *Neogloboquadrina pachyderma* (sinistral) strongly dominates the foraminiferal assemblage; the subpolar to temperate species *Globigerina bulloides* accounts for 10 to 25%. Other species account for up to 3% only. The shell $\delta^{18}O$ and $\delta^{13}C$ values of the species *N. pachyderma* (sin.) are compared to water $\delta^{18}O$ values and $\delta^{13}C$ values of dissolved inorganic carbon (DIC). The strong gradient in $\delta^{18}O$ composition and temperature in the upper water column is reflected in the $\delta^{18}O$ of *N. pachyderma* (sin.). Relative to the values expected for inorganic calcite precipitated under equilibrium conditions *N. pachyderma* (sin.) displays a vital effect of about 1‰ in $\delta^{18}O$. The $\delta^{13}C$ composition of *N. pachyderma* (sin.) is about constant with water depth and the reflection of $\delta^{13}C$DIC in the foraminiferal shell seems to be masked by other effects. Most foraminifera are found above or slightly below the thermocline and can be assumed to calcify in the upper 200 m of the water column. The gradient of $\delta^{13}C$DIC extends well below this depth, therefore the lack of correlation can partly be attributed to this fact. The remaining discrepancy between $\delta^{13}C$ *of N. pachyderma* (sin.) and $\delta^{13}C$DIC correlates with the carbonate ion concentration in the water column. This leads to the conclusion that the "carbonate ion effect" (CIE), which has been derived from culturing experiments for other species, is found here under natural conditions. When the magnitude of the CIE derived for *G. bulloides* is applied to *N. pachyderma* (sin.), CIE corrected $\delta^{13}C$ of *N. pachyderma* (sin.) are a direct reflection of $\delta^{13}C$DIC in the water column with a constant offset of 1.2‰.

EVIDENCE FROM THE LAPTEV SEA SHELF FOR THE TRANSFORMATION OF A LATE GLACIAL PERMAFROST LANDSCAPE INTO A MARINE DEPOSITIONAL ENVIRONMENT

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The Arctic comprises some of the most sensitive elements of the global environment, which are considered to respond rapidly to climate change. In this context the Laptev Sea and its Siberian hinterland are of particular interest because they link the polar margins to the Arctic Ocean and the World Ocean's circulation system. The north Siberian margin today is comprised of a permafrost landscape that has undergone major changes during Quaternary times. Moreover, there is evidence from modern data that the stability of the permafrost is in threat due to global warming. Such a change of the permafrost in the future is of major climatic relevance, considering a potential release of gashydrates that are now trapped in the frozen ground.

During the last 10 years, Russian and German scientists have systematically investigated the environmental system of the Laptev Sea to decipher the mechanisms which control past environmental changes in the Siberian Arctic. Numerous gravity sediment cores, with a maximum length of up to 9 m, were taken from this region during several ship-based expeditions. Interpreting the information contained in these marine archives has imminent implication for our understanding of global change on various time scales. Thus, these sediment cores allowed for a detailed reconstruction of the Laptev Sea paleoenvironment since the inception of the last postglacial sea-level rise.

A major step forward with regard to both scientific and technological achievements in Arctic paleoclimate research was the successful conduction of the TRANSDRIFT VIII expedition in summer 2000. This first scientific drilling campaign to the outer Laptev Sea shelf had the goal to recover sediments from the Cenozoic rift system of the eastern Laptev Sea to study Arctic climate changes on time scales beyond the Holocene. Because of the shallow water depth of the Laptev Sea shelf, this region became strongly affected by the cyclic global sea-level changes of the Pleistocene leading to the deposition of alternating marine and terrestrial sediments. A major objective of the expedition was therefore to investigate whether past sea-level lowstands caused the development of permafrost also in this outer shelf region and whether it became preserved in spite of ensuing marine transgressions which resulted in the deposition of non-frozen sediments. The cores recovered during the drilling campaign show the existence frozen sediments. This result verifies for the first time that in this part of the Siberian Arctic late Pleistocene permafrost remained preserved below unfrozen marine sediments of Holocene age.

HIGH-ARCTIC HOLOCENE RECORDS OF LAND-OCEAN INTERACTIONS

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Constrained by radiocarbon dates (AMS) sediment cores from the vast Siberian shelves provide direct insight into the histories of both circum-arctic sea-level rise since the last glaciation and postglacial land-to-shelf interaction. Today and also in the past, Arctic Siberian shelf seas in particular are subjected to large amounts of fresh waters discharged by central Siberian rivers. In the Laptev Sea, the riverine water is mainly directed along submarine channels. The river runoff and coastal erosion are major contributing processes for sediment delivery to the Laptev Sea shelf. Based on sediment cores from different water depths of these channnel, micropaleontological, sedimentological, and geochemical approaches are sensitive tools to reconstruct not only the inundation history of the shallow shelf itself, but also to determine the temporal variability of land-ocean interactions in the Arctic.

Stable carbon isotope studies of surface sediments and sediment cores of the Laptev Sea shelf clearly indicate the modern distribution pattern of terrestrial organic carbon. The $^{13}C/^{12}C$ ratio of organic matter in marine sediments is therefore not only useful to estimate the relative amount of organic matter derived from terrestrial and marine sources, it also helps to reconstruct the terrestrial fluvial input during the Holocene. In comparison with other proxy methods, such as XRF and magnetic susceptibility, the land-ocean connection was reconstructed for the western shelf region along the submerged Khatanga valley. This region is particulary suited for such investigations because it is directely linked to the Putoran Massif in the hinterland, a flood basalt province. The data reflect a variable input of terrestrial sediments since about 16,000 yrs ago that seems to indicate a certain periodic cyclicity.

That the Holocene river input to the Laptev Sea is largely governed by a dominant cylcicity is also record in the eastern shelf region. This may be derived from paleosalinity reconstructions based on diatoms and benthic foraminiferal $\delta^{18}O$. While the diatom record primarily reflects the southward retreat of the coastline during the postglacial transgression between 9,000 and 7,000 yrs ago as well as variable sea-ice conditions during the later Holocene, the foraminiferal data indicate changes in bottom water salinity with a recurrence period of 1,000 yrs over the last 8,500 yrs.

THE LAPTEV SEA SHELF HYDROGRAPHY UNDER VARIABLE ATMOSPHERIC FORCING DURING SUMMER

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The Laptev Sea hydrography is investigated through spatial and temporal salt and heat content distribution in conditions of variable river runoff impact and atmospheric forcing. It is the river runoff which determines thermohaline properties of the Laptev Sea shelf water. It has long been recognized that regularities of river water propagation over the shelf region are mostly controlled by atmospheric forcing. A theoretical study, as well as numerical simulations, demonstrate that upwelling favorable winds tend to thin the river plume and to spread it in an offshore direction, and in contrast, the plume is narrowed and becomes thicker under downwelling winds. However, none of the previous studies quantifies the shelf water hydrography response to the impact of river freshwater under variable atmospheric forcing on the base of long-term observations.

This study is essentially based on historical hydrographical, hydrological and meteorological data sets for the summer periods from 1965 to 2000. Two main mechanisms of the shelf water hydrography response to river runoff influx are established. They are associated with anticyclonic (ACCR) and cyclonic (CCR) atmospheric circulation regimes. Periods of prevailing cyclonic (1964-1971, 1980-1983, 1989-1995) and anticyclonic (1972-1979, 1984-1988) atmospheric circulation regimes have been determined in accordance wwith the results of hydrodynamic modeling of sea level transformation caused by wind in the Arctic Ocean by Proshutinsky and Jonson. Offshore wind persisted under ACCR tends to propagate river plume northward and to thin it. The secondary wind effect is to enhance river plume mixing and weakening of the density stratification, therefore making the plume more susceptible to shear-induced turbulent mixing. Under these conditions, river runoff causes not only the freshening of the surface layer, but also an integral salinization owing to mixing with the ambient salty water. Under these circumstances, multiannual fluctuations of the upper layer salt content have a positive correlation with river discharge. Onshore winds prevailing under CCR conditions prevent the northward propagation of the river plume, and, thus, the river discharge itself controls the surface layer freshening. In this case, the upper water layer salt content and river discharge are characterized by inverse correlation.

Our results give evidence that the bottom layer thermohaline regime is controlled by both advection from the north and convection through the pycnocline. River plume movement induces southward compensation currents in the layer below the pycnocline. Offshore winds prevailing under ACCR result in southward reversal currents in this layer with velocities up to 59 cm/s. Both currents mentioned lead to a salt content increase due to advection from deep northern regions with higher salinity. As a result, interannual variability of bottom layer salt content, especially under the ACCR, correlates well with the river runoff fluctuations (r=0,54). The thermal regime of the bottom layer is characterized by a positive correlation with river discharge under the ACCR. Upwelling events prevailing under ACCR may result in considerable plume mixing and weakening of the vertical density gradient favorable for convection. Under CCR conditions, the plume becomes thicker and stably stratified with limited vertical entrainment. In this case the thermal regime of the bottom layer is essentially formed by a southward compensation flow induced by river plume propagation.

HIGH-RESOLUTION CONTINENTAL PALEOCLIMCATIC RECORDS FROM LAKE BAIKAL SEDIMENTARY CORES

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The paper presents the results of ten-years deep drilling on Lake Baikal (joint Russian-American-Japanese Baikal Drilling Project). During the course of the project, five sets of boreholes were drilled in various geomorphic structures of the lake. Avalanche sedimentation has been established in deep basins of the rift lake. The sedimentation provides a great amount of plants producing methane of gas hydrates, which have been first found in the freshwater lake.

A precise age control of the Baikal sedimentary sections based on detailed paleomagnetic data as well as their continuity and a considerable length allowed us to obtain a unique paleoclimatic record, which may provide a reference model for Asia and the whole continental Northern Hemisphere. Boreholes on the Academician Ridge yield a record of more than 10 My with the age resolution of 500 to 250 years.

The trend of biogenic silica in the BDP-98 core exhibits a regular gradual cooling episode in Siberia, which has been taking place for the last 10 My. A sharp cooling episode occurred 2.8-2.5 My ago. This is evident from glacial clay layers in the BDP-96 and BDP-98 cores, which practically do not contain any diatoms. Palynological data correspond with the onset of a sharp cooling at that time accompanied by a major change in the plant composition of the region. Paleoclimatic records from Lake Baikal sediments agree well with the marine isotope records. However, short-term changes are more evident in the Lake Baikal sedimentary record. Correlation of the Lake Baikal record with the marine oxygen isotopic record shows that climate changes of Central Eurasia were not specific but follow the pattern of global climate fluctuations of the Northern Hemisphere as influenced by orbital forcing. Lake Baikal paleoclimatic records provide an accurate age of glacials and interglacials in various parts of Siberia as well as a comparison of the climatic changes having occurred in Siberia with those in Europe and Northern Atlantic.

SEASONAL VARIABILITY OF METHANE DEGASSING AT THE SEAFLOOR AND METHANE INPUT INTO THE ATMOSPHERE - RESULTS FROM THE JOINT RUSSIAN-GERMAN PROJECT KOMEX

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The Sea of Okhotsk and its marginal regions represent a system of plate tectonics, climate and ecology that affects the global climate considerably. The joint German-Russian project KOMEX (Kurile Okhotsk Sea Marine EXperiment) studies the mechanisms of the entire system and their influence on environmental parameters such as the global biogeochemical cycle, surface and deep-ocean circulation, global climate and plate tectonics.

On seven marine and one ice expedition within the framework of KOMEX, a complete annual set of hydrographical, geochemical and biological data for the Sea of Okhotsk was gained within the last two years. First results of these investigations show a clear, seasonal variability in all parameters and suggest Sea of Okhotsk Intermediate Water formation.

The seasonal and local variability of methane degassing at the seafloor and the methane input into the atmosphere were also recorded. Depending on the location, explicit seasonal differences in methane concentrations as well as almost constant degassing values were found over the year. Methane plumes of several hundreds of m height were observed by hydroacoustic methods in the water column along NE-Sakhalin. Water samples inside these

plumes yielded the highest methane concentrations ever measured in the Sea of Okhotsk of 23,000 nl/l. So far, it has been proved that the Sea of Okhotsk releases methane in the atmosphere the whole time and that an outstanding methane signal escapes into the atmosphere after the thawing period.

PORE WATER CHEMISTRY OF VENT FLUIDS ASSOCIATED TO MASSIVE BARITE DEPOSITS IN THE DERUGIN BASIN, SEA OF OKHOTSK

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Massive barite deposits of up to 10 m high build-ups are known from the seafloor of the Derugin Basin in the Sea of Okhotsk. Active fluid venting is indicated by the occurrence of chemosynthetic organisms, vent precipitates and methane plumes in the overlaying water column. Pore water analyses of sediment samples from three gravity cores taken within a distance of 3 km show extremely variable vent activities and fluid flow intensities. The cores were recovered from a strong, a weak and a non-venting site, respectively. The samples were analyzed for Ba, SO_4, Sr, Mg, Ca and $^{87}Sr/^{86}Sr$ isotope composition in order to investigate the Ba-source, the barite formation mechanism and the fluid flux rate. With increasing core depth, all elements in the non-venting sediment core diverge only negligibly from normal bottom water concentrations. In contrast, the increase of Ba up to 20 mM (which is 8000 times the normal sea water concentration) at 6 m core depth combined with the Sr increase up to 200 µM defines sites of strong venting activity. In the same core, the concentrations of Mg and Ca decrease from normal sea water values to 30 mM and 4 mM, respectively, and sulfate is already totally consumed at 2 m core depth. This consumption is also indicated by sulfur isotopes of the barite (_^{34}S 21.0 to 38.6 ‰) which document biogenic sulfate reduction. This indicates the mechanism of Ba-release, which is driven by the sulfate reduction of micro-organisms coupled with dissolution of scattered small barite grains. The pore water composition of the weak venting core site shows similar trends, however, with lower gradients. The 'weak core' pore water profiles run parallel to the profiles measured at the strong venting site. Here, the influence of the bottom water fluid can be recognized down to some cm below the seafloor. At the weak venting site, the bottom water influence can be recognized down to about 3 m core depth. This downward sea water flux in the sediment is also indicated by the $^{87}Sr/^{86}Sr$ isotope composition of the pore water, which points to a mixing of sea water (0.7092) and other fluids with lower, but unknown $^{87}Sr/^{86}Sr$ values (lower than 0.7084). At the strong venting site, the signal of the ascending fluid reaches up to 1 meter, while the fluid signal at the weaker site is already lost at approximately 3 meters. Using these pore water profiles, the fluid flow rate can be estimated to be 0.2 to 0.5 cm/year for the strong fluid vent site. In general, the analyzed cores indicate that active fluid venting of Ba-rich, sulfate-free pore water occurs at rather small scaled and like on-permanent cold vent sites.

CLIMATE CHANGES IN THE LAPTEV SEA REGION IN THE HOLOCENE AS INFERRED FROM DATA ON THE CONTINENTAL CIRCUMFERENCE

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The results of the work within our OSL 2001 Fellowship Program are project represented below.

Up to the present we had reconstructed the climate fluctuations for the last 10 ka for various parts of the Laptev Sea region, based on the pollen analysis of the sediments from the outcrops and lake bottom sediments. An analysis of the spore-pollen data is carried out for 39 sections of the Holocene deposits for which the radiocarbon dates are available.

The special variability of the vegetation zone limits had been reconstructed for the Laptev Sea region during the Holocene, also a number of paleovegetational maps have been drawn.

All the results are represented in the form of a data base with a personal interface, which can be published in the Internet and made available for all researchers.

The scientific results, obtained during the investigation, can be stated as following:

The Holocene climatic optimum was not simultaneous across the region of study. On Taymyr Peninsula it was timed to the period of 8,5 to 7,0 ka, as proved by the data from the sections in various parts of the Peninsula, including the brand new results of the Taimyr Lake bottom sediments analysis. On the arctic islands the Holocene optimum occurred earlier at about 10,0-9,0 ka which is proved by the pollen evidence from Severnaya Zemlya archipelago and Novosibirskiye Islands' sections.

The period 10,0-9,0 ka ago is characterized by the disturbance of the natural climatic zones, whereas the conditions on the arctic islands were more favorable than on the mountainous Taymyr and north Siberian Lowland. It is likely connected with the beginning of the sea level rise and the penetration of warm Atlantic waters up to the northern shores of the archipelagos.

The period 7,0-6,0 ka ago on the Taimyr Peninsula is defined as a time of active development of mountain valley glaciers, influencing on the modern relief. Also the traces of glacier, ending by the time of 6000 years ago, are found on Arga-Muore-Sise Island, adjacent to the Lena Delta from the northwest.

ARCTIC CLIMATE CHANGES DURING THE LAST 10,000 YEARS

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The present research is based on the significant volume of actual data assembled by the international scientific community for the last decades (CAPE project and Russian investigations). These data are more or less homogeneous since the interpretation of pollen spectra of Holocene deposits, which were investigated in various regions of Arctic, lies at their basis. The spatial and temporary fluctuations of arctic climate during long time intervals represent a complex picture. Three arctic climatic provinces were allocated. They are the Atlantic, Siberian and Canadian provinces. Warming and cooling occur there more or less synchronously. The correlation of long-term fluctuations of the climate between provinces is difficult. It appeared that even in the northern polar area of the earth climatic fluctuations essentially differ at the transition zone from one sector to another. We characterize the climate changing by relative units of paleovegetation oscillations, which mostly depend on summer air temperatures.

We have obtained the following results:

1. In general for the period of the last 10,000 years the general tendency to cooling in all considered sectors of the Arctic is observed. In all sectors the cooling process did not take place evenly. During the observed time, warming periods alternating with cooling periods were observed.

2. An estimation of the onset of a climatic optimum in various sectors of the Arctic has been made. The warmest period is observed not simultaneously in all Arctic and varies from 10,000 to 4,000 years ago.

3. The amplitude of climatic changes for the considered period exceeds the amplitude of changes observable in the last century, which allows to propose the natural character of the modern warming.

4. Three climatic provinces are observed by correlation relations between different sectors: the Atlantic, Siberian and Canadian ones.

NATURE AND RAPIDITY OF LATE GLACIAL CHANGES IN THE VARVED LAKE RECORD OF MEERFELDER MAAR, GERMANY

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The Late Glacial is a transition period of about 3,000 years when climate switched from a glacial to the present interglacial mode. The onset of the Late Glacial is marked by a major global warming which subsequently was interrupted several times by abrupt cooling. The trigger for this pronounced climatic instability is not yet fully understood. Common explanations include changes in the thermohaline circulation and solar irradiation changes or a combination of both.

Terrestrial environments in the mid-latitudes gradually ameliorated through pedogenesis and vegetation development during the Late Glacial. This climate-controlled evolution was disturbed and interrupted by periods of climate deterioration. The nature and rapidity of environment changes during sudden oscillations of climate are ideally recorded in annually laminated lake sediments.

The varved sediment record from Lake Meerfelder Maar provides an independent varve chronology enabling a precise comparison with the stable isotope records from Greenland ice cores. Varve facies analyses in combination with multiproxy data (e.g. biogenic opal, organic carbon, pollen) discriminates four major environment changes during the Late Glacial lasting from a century to more than a millennium. Within dating uncertainties these oscillations are synchronous to oxygen isotope excursions in the Greenland ice cores. However, similar oxygen isotope excursions correspond to clearly different environment responses. This might be related to either (1) different stages in the environment evolution, or, (2) differences in the appearance of climate fluctuations. Deciphering the latter might even be a tool to better understand climate forcing processes. A good example for (1) is the variation in environment response during the two major warmings at the onset of the Late Glacial and the Late Glacial/Holocene transition respectively. Despite almost glacial conditions during the Younger Dryas this cold period was too short for a complete reverse of the preceding environment evolution to a stage similar as it had been at the end of the glacial. In contrast, the causes for the environment change during the Gerzensee oscillation are not clear and might be related to a different type of climate change.

BENTHIC FORAMINIFERA EVIDENCE OF LATE QUATERNARY OCEANOGRAPHIC CHANGES IN THE SOUTHWESTERN OKHOTSK SEA

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Benthic foraminifera were studied in 63 sediment samples of KOMEX 1998 core LV28-2-4 (southeastern Sakhalin slope, 1265 m water depth). Based on the distribution of 11 dominant species, twelve ecozones were specified for the last 40? Kyr (MIS 1-3). The ecozones boundaries have been calibrated by interpolating them to the previous age model (Biebow et al., 2000). The evolution of the corresponding benthic foraminiferal community is related to climate-controlled organic fluxes and deep-water circulation.

The most important transformation of benthic foraminifera assemblages is associated with Termination 1 (12.5-8 Kyr). The two peaks in fauna abundance and species diversity are supposed to be related to maxima of bioproductivity during T1A and T1B events of global melting pulses. The assemblage structure indicates the highest organic flux during these events and a maximum influence of oxygen depleted NPIW and/or local oxygen depletion due to high bioproductivity. The Younger Dryas cold event affected only benthic foraminifera abundance, but not the species content.

The benthic foraminiferal fauna is more abundant and diverse in the Last Glacial (12.5-40 kyr) than in Holocene (since 8 kyr). This can be related to the absence of summer ice cover in the western part of the Okhotsk Sea during the Last Glacial. Strong stratification of the water column, high sedimentation rates of biogenic opal and/or carbonate dissolution could have affected the Holocene benthic foraminifera. The presence of a number of modern

species of the outer shelf and upper continental slope (Saidova, 1961) in the Last Glacial assamblages can be likely interpreted as an intensification of the SOIW near the southeastern Sakhalin slope. The gradual transformation of the Holocene assemblages to modern ones can be related to decreasing NPIW inflow and SOIW formation.

According to species content, organic fluxes slightly increase in response to the regional warming in Late Holocene (0.7-5.5 kyr), at the end of MIS-2 (19.3-12.5 kyr) and at the end of MIS-3 (33.7-29.2 kyr).

NEW DIGITAL BATHYMETRY MAP OF THE LAPTEV SEA

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The important question for all investigators of the earth is the knowledge of the relief in the study area. The task of compiling a bathymetry map for the Laptev Sea shelf area, which has long been intensively studied by the scientists of various disciplines, is one of the fundamental tasks of the "Laptev Sea System" project.

To produce the bathymetry map based on coherent datasets all available bathymetry information was digitized and presented in the GIS Arc/View. Several types of information were used:

- Regional bathymetry maps at a scale of 1:5,000,000 - IBCAO v.1 11.07.2001 and The Sea-Bed Relief of the Arctic Ocean, 1999, VNIIOkeangeologia, GUNIO, RAS.
- Bathymetry maps at a scale of 1:1,000,000 presented in the appendices for "The State Geological Map of Russia" and "The State Gravity Map of Russia".
- Bathymetry data from navigation maps.
- Bathymetry from echo-sounder and PARASOUND data, collected during the German-Russian expeditions to the Laptev Sea.

The datasets are presented in different forms – grids, contours, points and profiles. All this information was systematized and analyzed. As a result the bathymetry grid (2,5x2,5 km) was produced. Based on this grid the new bathymetry map of the Laptev Sea Continental Margin was composed in GIS Arc/View. Different kinds of computer analysis of used datasets were additionally carried out for the central part of the Laptev Sea. The preliminary version of the geomorphologic map was produced.

OTTO SCHMIDT LABORATORY FOR POLAR AND MARINE RESEARCH - MODERN TECHNICAL ABILITIES FOR SCIENTIFIC INVESTIGATIONS AND STUDY PROCESS

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The Otto Schmidt Laboratory for Polar and Marine Research was opened in St. Petersburg in October, 2000 at the State Research Center of the Russian Federation - Arctic and Antarctic Research Institute (AARI). This project is a part of Cooperative Agreement on polar and marine research between the Russian and German ministries of science and technology in order to support young Russian scientists and students in polar and marine investigations. The OSL consists of analytical, microscopy, and computer laboratories and a scientific library. The OSL is equipped with state-of-the-art standard laboratories for polar and marine research. The analytical laboratory is equipped with the following essential devices: autoanalyzer for nutrients SKALAR, C/N analyzer VARIO EL III ELEMENTAR, ionchromatograph METROHM. The brief descriptions of each tool are presented. There are also the following supporting tools: freeze-dryer ALPHA 1-4, mixer mill RETSCH,

centrifuge MEGAFUGE 3.0R, sonic sifter ATM, dry and muffeln ovens, hot plate, ultrasonic cleaner. The microscopy laboratory is equipped with a system microscope OLYMPUS SZX9 (binocular), a system microscope OLYMPUS BX60 with fluorescence attachment and a system microscope OLYMPUS BX50 (polarization). A description of the microscopes is presented in the poster also.The microscopes are connected with digital camera Color View12, which provides the possibility to get pictures on PC screen for analysis and data base creation. The computer laboratory is equipped with 11 PC Pentium III, 2 Servers and 1 PC Power Macintosh G4. The software (MS Windows 2000 Server, MS Windows 2000, MS Windows 98SE, MS Office 2000, MS Office XP, Adobe Photoshop 6, Adobe Photoshop 6 for Mac, Adobe Illustrator 8, Adobe Illustrator 8 for Mac, Corel Draw 9, ASP Linux 7.2, Borland Delphy 5, Golden Software Grapher 2, Golden Software Surfer 7, Star Office 5.2 for Linux) installed on the PC is licenced. The PCs are combined with the local computer net and have permanent access to the internet. There are also a black-and-white multifunctional center (printer, copy, fax) Ricoh Aficio 450, a color laser printer HP 4500D, and a color plotter HP DesignJet 1050C (format A0). In the library there is a set of international scientific magazines: Science (1999-2002), Nature (1999-2002), Berichte zur Polarforschung (1999-2001), Earth and Planetary Science Letters (1999-2001), EOS (1999-2001), Estuarine, Coastal and Shelf Sciences (1999-2001), Geochimica et Cocmochimica Acta (1999-2001), Geophysical Research Part C and Part D (1999-2001), Physical Oceanography (1999-2001), Limnology and Oceanography (1999-2001), Marine Ecology Progress Series (2000-2001), Paleoceanography (1999-2001), Monthly Weather Revue (1999-2001).

EXPERIMENTAL INVESTIGATIONS OF GAS HYDRATE FORMATION AND DISSOCIATION IN SEDIMENTS

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A lot of direct and indirect data about the possible presence of gas hydrates in permafrost both on land and offshore in the Arctic seas has been obtained within the last decade. However, gas hydrate formation and existence conditions are still open to discussion. The experimental materials on the study of hydrate formation and dissociation in artificially methane-saturated sediments are represented in the given work.

The physical modelling of hydrate formation and decomposition processes in dispersed sediments has been conducted in a special pressure chamber. The chamber is equipped with an automatic system of pressure and temperature registration. Pure methane was used to form hydrate. Gas hydrate formation/decomposition took place under cyclical temperature alteration at certain initial pressure conditions. Sediments of various salinity, grain size and mineral composition were used in the experiments.

The data on kinetics and temperature and pressure conditions of water phase transitions under methane pressure were obtained during the experiments. It was found out that only a part of the ground water transforms into hydrate and the rest of the water freezes in the negative temperature spectrum.

Temperature and pressure parameters of gas hydrate formation and dissociation in porous space are detected for the investigated sediments. The received experimental curves have shown an obvious deviation of P/T equilibrium conditions of hydrate formation/dissociation in the porous space to the field of higher pressures and lower temperatures when compared to the system "water (ice) - free gas - gas hydrate"($P/T_{g\text{-}w}$). These deviations are not constant. The values of deviations increase with temperature and pressure rise. The influence of soil salinity, grain size and mineral composition on the deviation of P/T conditions of gas hydrate existence is also quantitatively shown.

The experimental data on phase equilibriums of methane hydrates in sediments provide a new look at gas hydrate existence conditions in a dispersed medium and the gas hydrate stability zone in sediments. It plays an important role for mapping gas hydrate deposits and evaluating gas hydrate resources in sediments.

FORAMINIFERS OF THE LAPTEV SEA SHELF AS INDICATORS OF PALEOENVIRONMENTAL CHANGES

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Spatial distribution of recent foraminifers in the surface sediments and downcore variations in species composition were investigated in order to reveal the reaction of benthic foraminiferal assemblages to paleoenvironmental changes in the course of the Holocene transgression.

The distribution of modern foraminifers was studied through the analysis of coretop samples obtained in various parts of the Laptev Sea shelf and upper continental slope during the TRANSDRIFT V expedition and, also, published materials of the TRANSDRIFT I expedition (Bude, 1997). The maximum relative abundance of several index species was related to water depth and average bottom salinity. Though, in general, foraminifers are rather evenly distributed over the sea, it is possible to distinguish between assemblages restricted to the two main areas. The eastern shallow shelf affected by river runoff is inhabited by the inner shelf assemblage with predominance of the euryhalines species *Elphidium clavatum, E. incertum, E. bartletti, Haynesina orbiculare, Elphidiella groenlandica*. This assemblage is similar to river-proximal assemblages recorded in the other Arctic seas with considerable riverine input (Polyak et al., in press; McDougall et al., 1986). The deeper regions with an average bottom salinity of 32-34 are occupied by taxonomically diverse assemblages with species preferring river-intermediate and river-distal habitats (Cassidulina, *Elphidium subarcticum, Nonionellina labradorica, Pyrgo williamsoni, Cibicides rotundatus, Melonis zaandami*).

Fossil foraminifers were studied in the four AMS^{14}C dated sediment cores recovered during the TRANSDRIFT V expedition from the Lena (45, 32 and 21 m water depth) and Yana (51 m water depth) paleovalleys. The most pronounced changes in species composition of ancient assemblages occurred on the middle shelf during the early stages of inundation. In the Lena paleovalley, a taxonomically impoverished river-proximal assemblage existed ca. 11.2-11.0 cal. ka, that was replaced (11.0-10.8 cal. ka) by a transitional assemblage with higher species diversity. A marked peak in the total abundance of foraminifers corresponding to the transitional stage gives evidence for the active input of terrestrial organic matter due to fluvial runoff and coastal abrasion, but, compared to the previous stage, decreased sediment flux, as indicated by reduced sedimentation rates. The overlying taxonomically diverse shallow-marine assemblage with increasing relative abundances of *E. subarcticum, P. williamsoni* and *Cassidulina subrotunda* characterizes an environment more distant from the rivers. A similar succession of fossil assemblages is recorded in the Yana paleovalley (51 m water depth), where the main transition to the modern-like taxonomically diverse assemblages occurred about 11.1 cal. ka. An interesting feature of the basal foraminiferal assemblage from this core is the considerable share of planktic foraminifers (*Neogloboquadrina pachyderma, Globigerina bulloides, Turborotalita quinqueloba*) reaching 40-50%. A similar situation existed in the Lena paleovalley, where abundant planktic foraminifers occur in the lowermost sediment layer of the core from 32 m water depth known to be accumulated from 8.4 to *ca.* 7 cal. ka under freshened conditions at depths of less than 10 m (Bauch et al., 2001; Mueller-Lupp et al., 2001). The high portion of planktic foraminifers in extremely shallow environments is intriguing and probably results from advection of saline waters from the open sea area. When they meet riverine waters, planktic foraminifers die. Such a situation was recorded by Tamanova (1971) in the nearshore zone to the northwest off the Lena Delta. Another possible explanation is the redeposition of planktic foraminifers from the older marine beds.

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BARITES OF THE SEA OF OKHOTSK: SEDIMENTOLOGICAL AND MINERALOGICAL ASPECTS OF THEIR ORIGIN

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In order to study different features of barite mineralization in the Sea of Okhotsk the mineralogical and chemical composition of both host sediments and authigenic precipitates has been investigated in different cores from the Derugin Basin and on a submarine volcano in the Kurile Basin. These cores were correlated by litho- and biostratigraphy. Various types of carbonaceous, barite and sulfide mineralization have been distinguished and their distribution in the cores was analyzed. Based on this results, we believe that the intensification of gas-fluid emanations in the Derugin Basin during Holocene - Late Pleistocene has a cyclic character.

The paragenetic associations of authigenic minerals and the isotope composition of carbonates and barites from different areas of the World`s Ocean which are influenced by cold seep activities or hydrothermal fluids have been compared to the sediments from the Derugin Basin in order to discuss the genesis of barite mineralization in the Derugin and Kurile Basin.

THE DRIVERS OF SIBERIAN ARCTIC SHALLOW SEAS HYDROGRAPHY WITHIN THE SCALE OF SEASONAL AND INTERANNUAL VARIABILITY

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Atmospheric circulation, ice cover and river runoff are deemed to be the main factors affecting the shallow water environment in the Siberian Arctic. The high rate of variability for these agents results in sharp transformation of hydrographical features especially under shallow-water conditions. The seasonal scale of sea-ice extent and river discharge variability contribute primarily to the basic properties of water hydrography such as thermohaline circulation, vertical density stratification and turbulent exchange processes. The interannual scale of atmospheric circulation variability affects the river plume redistribution over the Laptev and Kara seas area. The interactions between all these processes as well as corresponding feedbacks are deemed to be very important for Arctic hydrography but have not been sufficiently investigated up to now.

The meteorological NCEP/NCAR reanalysis data (1965-2000), CTD-soundings and ADCP measurements carried out during the Russian-German TRANSDRIFT expeditions to the Laptev Sea (1993-2000) and Russian historical hydrographic data sets from 1965 to 1991, river discharge information (1965-1994), ice data (1979-1999) were examined to evaluate the linkage between atmospheric, ice, hydrographic and hydrological processes during various seasons of the year.

It is rather the predominance of cyclonic or anticyclonic atmospheric circulation over the Arctic Ocean than the river discharge itself which affects the river runoff water distribution on the Kara and Laptev shelves and the vertical density stratification. It controls the water

hydrography due to the interannual variability of the main water circulation features from the input of marine water onto the shelf to the output of the freshened water into the Arctic Ocean in the surface layer. Near the bottom there is a countercurrent compensating the output of the relatively fresh water to the north by an input of the intermediate Atlantic water to the south. The rate of vertical exchange through the density interface depends rather on atmospheric circulation than on river discharge because of the linkage of the rate of entrainment through the density interface to river plume dynamics.

It is the ice cover that strongly affects the seasonal variation of water dynamics. Under open-water conditions the wind-forced currents, orientated correspondingly to the prevailing atmospheric circulation, mainly contribute to the surface water circulation. Beneath the density interface, the compensation currents orientated in the opposite direction could provide the exchange with the Arctic Ocean mentioned above. The pack ice, unlike the fast ice, is not of critically important for the development of wind-forced currents. Nevertheless, an ice cover subjects the water dynamics to a tidal-forced regime rather than to a wind-forced regime. For the first time the rapid amplification of M_2 and S_2 tidal waves on the density interface under the ice cover in the Laptev Sea was obtained from the wavelet and harmonic tidal analysis of the yearly ADCP records. Probably it results from the nonlinear interaction between M_2 and S_2 harmonics under the ice cover and energy dissipation from tidal to high frequencies due to interaction with atmosphere under the open-water conditions. Moreover, it could provide the important feedback to the ice via the freeze-up delay or ice thickness reduction due to an increase of the vertical heat fluxes from the bottom layer because of the baroclinic tidal instability. It seems to be the vertical heat fluxes from beneath of the river plume in the Laptev Sea that are mainly responsible for freeze-up onset delay in correspondence to the diagnostic model calculation results for the falls of 1994-1999. The negative relation between summer river discharge and following winter fast ice extension to the north has been found out for the period of 1979-1994 in the areas of the Kara and Laptev seas affected by the river runoff. It also gives evidence for the valuable input from the vertical heat exchange to the ice cover formation during winter. The tidal phase moderation for about 20º, probably provided by friction with a stable fast ice cover, could also be an important favorable factor when evaluated in the sub-ice water layer.

GEOLOGICAL FACTORS CONTROLLING THE MORPHOLOGY OF THE EAST SAKHALIN SLOPE

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Sakhalin Island in the western Okhotsk Sea stretches in the N-S direction over a distance of more than 800 km. The main tectonic structure of the island is the N-S-striking Sakhalin Shear Zone (SSZ). It is characterized by dextral strike-slip motion and represents the recent boundary between the Okhotsk and Amur plates.

The morphology of the East Sakhalin slope changes significantly from north to south. The analysis of the bathymetric and seismic data obtained in the framework of the KOMEX project (**K**urile-**O**khotsk Sea **M**arine **EX**periment) shows that this morphology is controlled by many factors, of which the most important are: the basement structure, high sedimentation rates, current direction, tectonic regime of Sakhalin Island, mass wasting processes and gas venting through the sedimentary column.

On the northern slope, mass wasting processes play a primary role in forming the slope morphology. Recent tectonic activities of the SSZ probably govern this process, because the diffuse seismicity of northern Sakhalin continues onto the slope here. Deformation zones mapped on the northernmost slope are associated with a system of reverse faults. Their locations correlate with the gas seep distribution.

The southern slope is seismically inactive. Accordingly, its morphology is controlled largely by currents and structural peculiarities. The width of the slope increases to the south, where the currents approach the basement high of the Polevoy Ridge which strikes oblique to the slope trend. This high serves as a barrier for the sedimentary material carried

by the currents. Peculiarities in the relief of the southern slope are also mainly current-controlled.

RIFT TO DRIFT TRANSITION IN THE LAPTEV SEA: GEODYNAMICS AND ENVIRONMENTAL IMPACT

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The epicontinental Laptev Sea (LS) forms an eastern rim of the Eurasia spreading oceanic basin in the Russian Arctic. It is one of a few places globally where a currently active mid-oceanic ridge (the Gakkel Ridge) approaches a continental margin. Because of this tectonic setting, the LS represents a unique natural laboratory for addressing the processes of breakup of continents and their impact on natural environment. Fundamental studies of this phenomenon have been undertaken during the past 15 years by several Russian and German institutions. The present-day data set consists of ca. 30,000 km of multichannel seismic reflection lines and a considerable amount of environmental data collected within the framework of the Russian-German program "Laptev Sea System". These data provide a good basis to delineate the processes causing the rift-to-drift transition and their possible environmental impact.

The transpolar mid-ocean Gakkel Ridge terminates against the LS continental slope where it is buried under a thick cover of terrestrially derived sediments representing a rare example of a sedimented active spreading axis. Based on seismic reflection and gravity data, the sediment-covered spreading axis is traced to the continental rise. The further continuation of the divergent axis into continental slope can be attributed to two asymmetric grabens, which terminate against the prominent Khatanga-Lomonosov Fracture. Hydrothermal faunal remnants and high heat flow (83-114 mW/m^2) found around these grabens in the up-slope area are typical for an oceanic spreading axis. Thus we consider these grabens as an extreme end of the global Atlantic-Arctic spreading system.

The character and magnitude of the extension dominating the near-Laptev part of the Eurasian Basin has not yet been defined. Low intense poorly differentiated linear magnetic anomalies are still present in this part of the basin suggesting a spreading environment. The axis is manifested by a negative magnetic anomaly that may suggest the constructive crust is either significantly reduced or not present in the buried rift valley at all. The high amount of normal faulting affecting both the buried ridge itself and the overlying sedimentary cover is an evidence of brittle deformation. These facts may be considered as the evidence for an unstable spreading under the ultraslow plate divergence.

In a modern tectonic setting the LS is an area of interaction of the North American and Eurasian lithospheric plates. The seismicity allows assuming that the present-day divergent plate boundary passes from the Gakkel Ridge to the eastern part of the LS with an offset of about 150-160 km along the Khatanga-Lomonosov Fracture. Active normal faulting, which is detected by the high-resolution seismic data and the PARASOUND echosounder records, affects the sea-bottom morphology that, in turn, causes a pattern of the near-bottom currents, distribution of water masses, sediment transport paths. This gives evidence that the active extension rupturing the continental lithosphere of the LS influences the processes occurring in the modern marine environment.

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ACOUSTIC IMAGING OF THE SUBMARINE PERMAFROST IN THE LAPTEV SEA

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Epicontinental Laptev Sea (LS) occurs between Taymyr Peninsula and New Siberian Islands in the Russian northeast. It is an example of a strongly coupled river-shelf-basin natural system evolving under a strong influence of active extensional tectonics along the boundary between North American and Eurasian lithospheric plates. The submarine permafrost (SMP) was initially discovered there in the 70s by exploration drilling around the New Siberian Islands, and then was numerically modeled (Kholodov et al., 2000) and verified in 2000 by drilling during the TRANSDRIFT VIII expedition in the northeastern part of the shelf (Kassens et al., 2000). The cores show the top of SMP of both ice-bearing and ice-bonded types to exist in places as little as 9 to 12 m below the seafloor.

Since the drill sites have been seismically defined by a high resolution 3.5 kH PARASOUND acoustic survey during the 1998 voyage of RV "Polarstern", these data are of great importance for mapping the SMP top. Acoustic pattern and physical properties of the top of submarine permafrost in the Eastern Laptev Sea and their relationship to sea-bottom morphology and tectonic setting are the main targets of the ongoing Otto Schmidt Laboratory project OSL-01-07.

Four main acoustic units (AU1-AU4 upward) have been recognized on all the profiles interpreted. They are considered as acoustic expressions of the different units of the subbottom sedimentary section. AU1 represents an interval of the PARASOUND record lacking almost any reflectivity at all. In many cases it is topped with a sharp reflector and is interpreted to represent both ice-bonded and ice-bearing SMP, as consistent with the drilling results. In other areas the AU1 is replaced upward by AU2 with a moderate reflectivity. There is no sharp boundary between the two units, and the strongest reflector is related to the top of AU2. The AU4 is an uppermost unit of a variable thickness (a few tens of centimeters to 10-12 meters) with a relatively transparent acoustic pattern, i.e. containing either a few or no strong reflectors. The presence of AU3 is limited to some specific areas, where it occurs between AU1 and AU4 based on and topped with prominent reflectors. Strong reflectivity is a characteristic sight of the unit, which makes it well recognizable over the area surveyed.

The fifth unit AU5 is a clearly superimposed acoustic pattern. It occurs in a shape of white patches either locally or over significant parts of the profiles masking AU1-AU4. The comparison of the PARASOUND record with 3.5 kH records from other distant areas has shown that the AU5 may be considered as a result of gassy sediment occurrences, i.e. sediments containing some quantity of free gas.

To interpret the PARASOUND record in terms of recent climatic changes we have applied a three-stage model of LS evolution based on Alekseev (1997), Bauch et al. (1999), Romanovskii et al. (2000). According to these authors, the large parts of the present-day LS shelf were situated above a low-stand sea level at the last glacial maximum terminated at about 15 Ka BP, and were deeply frozen. Both accumulative (ice-complex) and denudation areas were complicated by thermokarst lakes and river channels, which are suggested to have been underlain by taliks. This lowland was then flooded during the Holocene transgression between 12 and 6 ka BP. Thus, we infer AU1 to consist of pre-Holocene SMP including the buried relicts of the ice-complex, AU2 to represent thawed sediments as a result of possible permafrost degradation in subaquatic conditions, AU3 to be composed of terrestrial sediments accumulated both in large taliks and erosional channels, AU4 to consist of marine Holocene muddy sediments.

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MODELING PERMAFROST AND GAS HYDRATE STABILITY ZONE IN THE LAPTEV AND EASTERN SIBERIAN SEAS

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The long-term climate fluctuations, transgressions and regressions of the arctic seas have caused the formation and evolution of shelf permafrost and the Gas Hydrate Stability Zone (GHSZ). The reason for the regression and transgression cycles for the Laptev and Eastern Siberia shelf seas are glacial-eustatic fluctuations of World Ocean level. The aim of this paper is to present results on shelf permafrost thickness and GHSZ evolution modeling. The modeling has been made using a two–dimensional mathematical model provided by G.S. Tipenko et al. (1990, 1999). The model is based on the solution of the Stefan problem by the method of finite differences.

The paleogeographic scenario used in the calculation encloses the middle–late Pleistocene and Holocene (last 400 kyr), i.e. the last four climatic and glacial-eustatic cycles. The scenario was determined by Gavrilov et al. (1999). In the modeling the curve of hydrate formation for fine grained deposits (Chuvilin and Perlova, 2000) was used. The model makes the following assumptions:

The pressure of ground water below the permafrost base is equal to the hydrostatic one due to the existence of open taliks below the river channels and active tectonic faults.

Sea transgression leads to formation of additional pressure ΔP that depends on sea water depth.

The influence of the salinity of interstitial water is not considered.

Complete gas saturation in pores of the deposits was assumed; ground water reacts with gas during gas hydrate formation.

The pressure in the system is equal to the hydrostatic one;

A gas migration during gas+water⇔hydrat formation-dissociation also was not taken into consideration.

Calculations were made for the geothermal heat flow-q_{gt} with the value 50 mW/m^2, which is typical for undisturbed blocks of the lithosphere in this region. Besides this, values of geothermal heat fluxes, equalling 80 and 100 mWt/m^2, were assumed for the rift zones on the Laptev Sea shelf. Calculations which take into consideration a permafrost zonality of mean annual ground temperature (equal to 1°C for one degree of latitude) for latitudes 70º-78ºN, the sea water temperature equalling –2.0°C and a sea depth range of 0, -10, -15, -20, -25, -30, -40, -45, -50, -60, -80, -100 m were carried out.

In accordance with simulation results the following conclusions can be made:

The dynamics of the GHSZ thickness is similar to the permafrost thickness evolution on the lowlands and the shelf during periods of sea regression. That is a reason for the GHSZ increasing simultaneously with increasing permafrost thickness. In the outer part of the shelf the dynamics of permafrost thickness and evolution of GHSZ are different during periods of transgressions. The differences depend on GHSZ position from both the temperature condition and additional pressure caused by sea depth fluctuation.

Due to an increase of geothermal heat fluxes, a decrease of both permafrost and GHSZ thickness takes place. The thickness of both permafrost and GHSZ decrease with increasing present-day sea depth. The reason for the regularity mentioned above is a decrease of freezing time and an increase of permafrost degradation time.

Using the simulation results schematic thickness maps both of permafrost and of GHSZ have been compiled for the recent environment conditions. The highest thicknesses both of permafrost and GHSZ are near the Novosibirskiye Islands. That is the reason for lower mean annual ground temperatures during emergent periods and shallow sea water depths.

The permafrost and GHSZ thickness values decrease towards the shelf edge. There is no permafrost at a depth of 100 meters at the present time. The HSZ thickness values are nearly 300 meters there. The presence of GHSZ at the shelf edge is caused by surplus water pressure.

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SEA LEVEL AND GLACIATIONS OF TAIMYR PENINSULA IN THE LATE PLEISTOCENE

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The ongoing research within the framework of the «QUEEN» international project and the "Laptev Sea System" Russian-German research program has provided an amount of field material that allows the reliable radiometric dating of Late Pleistocene deposits of Taymyr Peninsula. Herewith we present the dating results of several sections which can be considered stratotypical for the regional stratigraphy of Late Pleistocene. The sections are well equipped with absolute age determinations by the ESR, U/Th, OSL and ^{14}C methods.

These data made it possible to correlate stratigraphic and paleogeographic schemes suggested by V.N. Saks, commonly used by Russian geologists for the interpretation of Late Pleistocene deposits of Central Siberia and the global oxygen isotopic scale.

The correlation work gave the following results valuable for the paleogeography of Taymyr Peninsula.

The 5e stage of the global oxygen isotopic scale correlates with the marine (shallow water, beach and delta) Kazantsevo (Sanchugovsky, by V.N. Saks) deposits dated by ESR as 156-111 ka. In terms of paleogeography, this is the period of the onset and maximum of the marine transgression that took place in the first half of the Late Pleistocene. The modern altitude of its terraces ranges from 50 to 200 m above sea level (a.s.l.).

The 5d and 5c stages of the global oxygen isotopic scale correspond to marine, glacial-marine and glacial deposits on Taymyr Peninsula. For this period, we suggest an increased tectonic activity with differentiated movements, slight lowering of sea level, a cooling and glacier development on land.

The 5b and 5a stages relate to Early Murukta (or Kazantsevo by V.N. Saks) marine deposits ESR-dated as 96-71 ka. This was the termination of the transgression. Contemporaneous terraces occupy the heights of 60 to 120 m a.s.l.

Stage 4 can be paralleled both to marine (70-47 ka by ESR) and terrestrial (fluvial, glacial and glacial-lacustrine) deposits of the Murukta sequence (Zyriansky one by V.N. Saks). They document the rapid regression of sea and the growth of glaciers.

Stage 3 refers to the Karga period represented mainly by lacustrine and fluvial deposits, including some estuary facies (ESR date of approximately 42 ka). Environmentally, this period can be characterized by the stabilization of sea level at 10-15 m above the modern one as a result of the general regression. The terrace was formed in river valleys and lake depressions that occurs in the modern topography at 30-50 m a.s.l.

Stage 2 is nothing else but the Sartan deposits (lacustrine, fluvial and glacial deposits). This is the time of profound sea regression and wide development of passive ice caps.

Hence, the transgression of the beginning of the Late Pleistocene on Taymyr Peninsula was not confined by the stage 5e of the global oxygen isotopic scale but has to be timed as the entire stage 5, and a deep regression with the lowering of the sea level below the modern one occurred only at stage 2.

724-METER DEEP ICE CORE FROM ACADEMY OF SCIENCES ICE CAP (SEVERNAYA ZEMLYA) - ACCUMULATION RATE, PRELIMINARY TIME SCALING AND DATA RESOLUTION

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The paper presents first results from the upper part of a 723.91 m ice core drilled on Academy of Sciences Ice Cap in 1999-2001, supplemented by data from shallow ice cores. The glacier's peculiarity is the infiltration and refreezing of melting water changing thereby original isotopic and chemical signals. Therefore, interpretation of stratigraphy in these ice cores is more difficult than in those from Central Greenland or Antarctica. On the other hand the amount of meltwater can be considered as a measure of summer warmth. The ice percentage (in weight %) reflecting summer temperatures are given for the upper 244.63 m of the core. Dating was done by help of data from dielectric profiling (DEP) showing considerable peaks in conductivity; some of which are interpreted as volcano events.

Chemical analyses of major ions show that the process of melting and refreezing left its mark to the pattern of ion distribution. However, the 1963 maximum of artificial radioactivity from atmospheric nuclear tests is clearly detectable in the deep ice core and the $\delta^{18}O$ profile of a neighbouring 12.82 m shallow core shows annual variations. At least for the upper part of the main core an almost seasonal time resolution of paleoclimate record could be expected. The Chernobyl layer is detected by increased ^{137}Cs activity in depths between 11.81 m and 12.51 m related to the AD 2000 surface. The resulting mean annual net mass balance is 53 +/- 2 g $cm^{-2}a^{-1}$. This value is in good agreement with about 45 g $cm^{-2}a^{-1}$ calculated from the 1963 layer.

MULTY PROXY HIGH-RESOLUTION PALEOCLIMATE RECORDS FROM LAKE BAIKAL: ORBITAL FORCING DURING THE LAST MILLION YEARS AND MILLENNIAL-SCALE CLIMATE CHANGES DURING HOLOCENE AND LGP

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X-ray fluorescent analysis with synchrotron radiation (SRXFA) was used for high resolution (2ky) studying of the distributions of elements in sediments of Lake Baikal over the time interval of Brunches Epoch (0-780 ky BP). The concentrations of some elements and their ratio respond to changes of the climate. Sr/Ba, Sr/Rb, Sr/Cs, U/Th, Zn/Nb, U, Mo and Br positively correlate with the content of biogenic silica (BiSi), diatom frustules content (Fr) and sediment humidity (WC), which are high at intervals belonging to interglacials and small in those belonging to glacials. On the contrary, to warm records Ba, Rb, Cs, Th, La, Ce, Nd, La/Yb, La(Ce)/Y(Zr) anticorrelate with BiSi. These two series of geochemical signals, along with BiSi, reflect oscillations of the climate between glacials and interglacials. Spectral analysis of the records revealed that they are modulated by orbital forcing. All Earth's orbital periods: eccentricity –96ky, tilt–41 and 54ky, precession–23and 19ky are present in the records. This proves that the climates of East Siberia depend on orbital forcing to the same extent as does the global climate.

The direct U-Th dating of MIS5.5 (Kazantsevsky interglacial in Siberia) and MIS7.1 was carried out. It has been found that the age of 6/5 termination on Lake Baikal is ca.132-135ky, and the age of maximum diatom production is ca. 125-128 ky. Thus, the depth-age model of the sediment from Lake Baikal over MIS5.5 is very close to the EGT4 age model of MIS5.5 for Vostok ice core. A comparison of the climate records found in the sediments

of Lake Baikal with the pattern of orbital parameters combined with the direct U-Th dating made it possible to estimate the mean rates of sediment accumulation over different time intervals and to refine the age-depth model for Lake Baikal during Brunches Epoch.

The scanning SRXFA station was created for a most detailed research of sedimentary records. The interval of the Baikalian core with 3-meters length covering the Holocene and MIS2-3 (representing Sartan glaciation and Karga warming in Siberia) was scanned with a resolution ~20y (1mm). Such a study is the highest resolution from the Baikalin investigation and it is comparable to the best ocean investigations. It has been found that pervasive millennial-scale glacial-interglacial cycles took place during this period. The mean interval between such cycles over the Holocene is about 2000 y. All D/O (Dansgaard-Oeschger) events have been detected during LGP in the sediment. The millennial-scale glacial-interglacial cycles observed on Lake Baikal and related with D/O events in Greenland ice are the direct proof of Eurasian teleconnections to the North Atlantic Ocean.

HIGH-FREQUENCY SURFACE ENVIRONMENTAL AND SEDIMENTARY CHANGE IN THE OKHOTSK SEA DURING LATE PLEISTOCENE: GEOCHEMICAL, PALEONTOLOGICAL AND LITHOLOGICAL EVIDENCE

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The Okhotsk Sea sediment cores, recovered during Nesmeyanov 25 and Lavrentyev 96 and 98 cruises, were studied by using oxygen and carbon isotope in planktonic and benthic foraminifera, diatom and pollen microfossils, organic and carbonate carbon, ice rafted debris and other lithological proxies.

In addition to the major Milankovitch-scale changes, the lithological, geochemical and paleontological indices show suborbital oscillations in the Okhotsk Sea hydrology, sedimentation and regional climate, too. These shorter-term oscillations are characterized by coupled maxima in ice rafted debris, sediment coarse fraction and sediment magnetic susceptibility (lithodynamic indices, LDI) values. Most of them are associated with cold events involving an enhanced winter ice formation and an intensification of the SOIW and NPIW formation. The terminations of the maxima in the LDI indices were induced by a climate warming and reduction of the ice formation and were accompanied by sharp decreases in planktonic foraminifera $\delta^{18}O$ and rises in $\delta^{13}C$.

During glacial terminations at the end of MIS 2 and 4, the onset of suborbital-scale LDI maxima took place close to sharp negative $\delta^{18}Opf$ and positive $\delta^{13}Cpf$ shifts forced by climate warming. In these special cases, the LDI maxima occurred under warm climatic conditions and rising sea levels and did not lead to increases in the Okhotsk Sea or North Pacific intermediate water ventilation.

STRUCTURE AND CRUSTAL HISTORY OF THE LAPTEV BASIN

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3D-modeling of the earth's crust in the central and eastern Laptev Sea was made on the basis of available seismic and potential field data. Seismic materials were used from more than 30 profiles shot by Russian and joint German-Russian expeditions in 1985-1997. Seismic boundaries identified by Russian researchers were correlated with those proposed in BGR interpretation. The entire set of seismic data was subsequently digitized, and structural maps for major seismic horizons were derived.

The results of the analysis demonstrate a complicated multi-stage character of sedimentation in the region. The upper sequence of the sedimentary cover is contemporary

to the formation of the Gakkel Ridge, i.e. not older than 10-12 m. y. The middle sequence was deposited mostly in a deep-water environment simultaneously with the Cenozoic evolution of the Eurasian Basin. The lower sequence whose thickness exceeds 8 km was accumulated predominately in Mesozoic time.

The next step was to construct a 3D-density model of the earth's crust through the solution of direct and reverse problems. For the determination of gravity sources, a grid-approximation base was used that enabled the computation of densities within pre-specified limits with fixed geometry of the entire lower semi-space (3D-solution).

The distribution of different types of acoustic basement was identified on the basis of a complex interpretation of potential field and seismic data and results of 3D-modeling. The following basement types were recognized: (a) "normal" granite-metamorphic layer characteristic of continental platforms; (b) folded basement of supposedly Mesozoic age; (c) reduced granite-metamorphic layer beneath a thick sedimentary cover.

Our research revealed no features suggesting the existence of a divergent boundary in the Laptev Basin throughout the entire Cenozoic era. It is, however, probable that young (Pliocene-Quaternary) longitudinal divergent zone is currently forming west of Belkovsky Island and may be traced across a sub-latitudinal transform fault to the eastern termination of the Gakkel Ridge.

MASSIVE BARITE DEPOSITS AND CARBONATE MINERALIZATION IN THE DERUGIN BASIN, SEA OF OKHOTSK: PRECIPITATION PROCESS AT COLD VENT SITES

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An area of massive barite precipitations was studied at a tectonic horst in 1500 m water depth in the Derugin Basin, Sea of Okhotsk. Seafloor observations and dredge samples showed irregular, block- to column-shaped barite build-ups of up to 10 m high which are scattered over the seafloor in a distance of 20 to 100 m. The white to yellow barites show a very porous and often layered internal fabric. Typically, they are covered by dark-brown Mn-rich sediment; EMS measurements of barite sub-samples show a Ba-substitution of up to 10.5 mol% of Sr. Rare idiomorphic pyrite crystals (~ 1%) in the barite fabric imply the presence of H_2S. This was confirmed by clusters of living chemoautotrophic tube worms (1 mm in diameter) found in larger pores and channels. Small fields of chemoautotrophic clams (*Calyptogena* sp., *Acharax* sp.) at the seafloor are an additional evidence for active fluid venting.

Microscopic examination showed that micritic aragonite and Mg-calcite aggregates or crusts are also common authigenic precipitations in the barite fabric. Equivalent micritic carbonates as well as barite-carbonate-cemented worm tubes were recovered from sediment cores taken close to the barite build-up area. One core also contained shells of *Calyptogena* sp. at different core depths with ^{14}C-ages ranging from 20,680 to >49,080 yrs. suggesting that fluid seepage must have been active for at least that period of time. Negative $\delta^{13}C$ values of this carbonates (> -43.5 ‰ PDB) indicate methane as major carbon source; $\delta^{18}O$ values between 4.04 and 5.88 ‰ PDB correspond to formation temperatures which are certainly below 5°C. High methane concentrations in the water column show that methane expulsion and probable carbonate precipitation is a recently active process.

Pore water analyses reveal that fluids also contain high amounts of Ba, they also show decreasing SO_4^{2-} concentration and a parallel increase of H_2S with depth. Additional, S and O isotope data of barite sulfate ($\delta^{34}S$: 21.0 to 38.6 ‰ CDT; $\delta^{18}O$: 9.0 to 17.6 ‰ SMOW) strongly points to biological sulfate reduction processes. The isotope ranges of both, S and O can be exclusively explained to be the result of a mixture of residual sulfate after a biological sulfate reduction and isotopic fractionation with 'normal' sea-water sulfate. While massive barite deposits are commonly assumed to be of hydrothermal origin, the assemblage of chemoautotrophic clams, methane-derived carbonates, and non-thermally equilibrated barite sulfate strongly implies that these barites have formed at ambient bottom water temperatures and are hence features of a *Giant Cold Vent* setting.

COASTAL DYNAMICS OF THE LENA DELTA, THE LAPTEV SEA, SIBERIA

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During the last decade the Laptev Sea coastline dynamics was investigated in detail at a number of erosion coastal sites, mainly along ice-rich coasts. Nevertheless, there are some gaps in respect to evolution of the accumulation coastal forms and retreating erosion banks and sandy cliffs in the Lena Delta. Previous studies of northern erosion sandy coasts and eastern banks of the Delta (1999-2000) have showed that the rate of retreat of such shores is quite high - up to 5 m per year (the average retreat rate is 1.5-2.5 m per year). Such rates are comparable with the rate of retreat of the eroded Laptev Sea coast consisting of an Ice Complex. However, there was no reliable information about shoreline dynamics in the area where accumulation and erosion processes proceed jointly. Such a section of 100 km length, which is characterized by the active sedimentation in the near-shore zone, was selected on the western coast of the Lena Delta.

In July-August 2001, within the framework of the "Laptev Sea System 2000" project, the field studies of the chosen section were conducted by the coastal team of the Russian-German expedition "LENA 2001". Seven key sites, including retreating erosion sandy shores with low ice content and accretion longshore sandbars (barrier islands), were investigated in order to define the long-term (about 30 years) rates of shoreline changes. Geodetic measurements have been carried out at the key sites, using a laser theodolite, to obtain the modern areal and altitudinal position of the shores. Theodolite profiles and bench marks recorded in the field were identified and compared with the aerial photographs and maps.

A preliminary analysis of our field data shows that the rates of shore accretion and retreat are quite moderate in this area. The average rate of cliff retreat is 0.6 m • year^{-1} (0.2-1.5 m • year^{-1}). The lowest rates of retreat belong to cliffs blocked by vast shallows, and the highest rates belong to sites adjacent to a relatively deep shoreface. Displacements of the crest of the long and narrow barrier islands in both offshore and onshore directions as large as 2.5 m/year during 32 years were measured in several sections. But these islands remain relatively stable. Only marginal parts of barrier islands show a distinct movement toward the land. On the whole, the investigated area represents a complicated erosive-accumulative coastal system dominated by shoreline motions toward the land.

New field data allow a more precise evaluation of the Laptev Sea coastal dynamics and sediment balance, and the promotion of a better understanding of climate drivers of the north and the Arctic coast evolution.

NEW DATA ON LATE QUATERNARY TERRESTRIAL PERMAFROST DEPOSITS OF THE LAPTEV SEA REGION BY IR-OSL, RADIOCARBON AND U/TH AGE DETERMINATION

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During the last four years a large amount of age determinations were carried out for the reconstruction of the Quaternary paleoenvironment in the Laptev Sea region. We worked in three different areas (Western Lena Delta, Bykovsky Peninsula, Bol'shoy Lyakhovsky Island). The geochronological studies focused on radiocarbon methods (conventional and AMS), Infrared Optical Stimulated Luminescence (IR-OSL), and ^{230}Th/U analysis. Radiocarbon age determinations are quite commonly used for organic-rich sediments, peat or

animal remains. The period covered by the radiocarbon method is up to 50-60 ka BP. The IR-OSL is a young method for dating the event of sediment deposition. This method dates anorganic sediment grains like feldspar. Thus sediment must not necessarily contain organic matter, which is a great advantage. The range of this method is up to 150-200 ka. Moreover for the first time peat in permafrost deposits was dated by ^{230}Th/U-analysis. This method is capable of dating up to 500 ka. The combination of these different geochronological methods enhances the information benefit but shows also new problems especially in the dating of permafrost deposits. The most important results of age determinations will be presented and some possible reasons for age differences are specified.

On Bol'shoy Lyakhovsky Island the oldest permafrost deposits are dated by ^{230}Th/U analysis at about 201±3 ka. The overlaying deposits were dated according to IR-OSL between 142±22 and 96±15 ka. Some samples in these deposits seem to be older than 150 ka. The base of the typical ice rich deposits called "Ice Complex" was dated once with 133±21 ka. The same site was dated by radiocarbon AMS at about 50 ka BP. On Bol'shoy Lyakhovsky Island the radiocarbon data do not correlate very well either with IR-OSL data or with other radiocarbon ages in similar outcrop positions.

At the other studied sites the radiocarbon chronology is significantly better. A very close age-height correlation could be used for paleoenvironmental reconstruction of about 60 ka on the Bykovsky Peninsula. In the western Lena-Delta the radiocarbon ages are in good accordance with the stratigraphical position of dated permafrost deposits. For the organic-free sandy deposits of the Arga Muora Sise Island in the northwestern Lena-Delta the IR-OSL age determination gives evidence for a Late Pleistocene formation of these special deposits (13.4±1.1 to 12.0 ±1.1 ka).

At about 50 ka BP and before the differences between IR-OSL and radiocarbon datings are very large at all study sites.

Open questions in the age determination of permafrost deposits are the problems of locally complicated conditions of geological and geocryological formation, the problems of geochemical migration in frozen ground, the role of ice for luminescence dating and the importance of Late Pleistocene weakening of the earth's magnetic field. Therefore more intense methodical as well as field studies are necessary for the combined application of geochronological methods.

TERMINATION OF THE GAKKEL RIDGE IN THE LAPTEV SEA

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A variety of data on the geological structure of the Laptev Sea continental margin and the adjacent part of the Eurasian Basin was assembled and analyzed in the course of compilation of 1:1,000,000 sheets T-49-52 and T-53-56 of the State Geological Map of the Russian Federation. This part of the Eurasian continental margin is unique for a T-type termination of the mid-oceanic most slowly spreading Gakkel Ridge against the Laptev Sea continental crust. A comprehensive analysis of detailed bathymetry, HRS and MCS data supplemented by interpretation of modern seismic activity of the Gakkel Ridge led us to the following conclusions:

A thick sedimentary pile completely fills the rift valley and indicates the predominance of a stable tectonic environment resulting in an almost complete burial of the Gakkel Ridge and lack of its expression in bottom topography of the continental rise and the base of the continental slope. The sediments are, however, dissected by post-Miocene faults suggesting short impulses of tectonic activity. Seismic sequences in the sedimentary cover reveal a dome-shaped configuration emphasized by onlapping of the reflectors observed in the lower part of the sedimentary section in Nansen and Amundsen basins on the respective slopes of the Gakkel Ridge. These and other features give reason to believe that the oceanic rift of the Gakkel Ridge developed within the pre-existing sedimentary basin whose eastern part occupied by the Laptev Sea shelf, slope and rise are at present subject to extension that may or may not lead to propagation of the rift.

MORPHOLOGY OF THE CONTINENTAL MARGIN OF THE LAPTEV AND EAST SIBERIAN SEAS

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The results of the morphological analysis of the original bathymetry data accompanying the 1:1,000,000 sheet series of the State Geological Map of Russia were summarized in the geomorphologic map of the Laptev and East Siberian seas' continental margin. The main morphological elements and individual forms were revealed. The relief of the continental slope has a rugged appearance due to an abundance of underwater canyons, structural ridges and tectonic scarps. These features are most characteristic of the continental slope off Severnaya Zemlya Archipelago and the portion of the continental slope between the Gakkel and Lomonosov ridges. The junction of the Lomonosov Ridge with the continental margin shows a more gentle topography which is also observed in the area of Starokadomsky trench - trough.

In general the continental slope consists of numerous sub-horizontal forms (terraces) with an extent of up to 25-30 km and a width of up to 10 km. The terraces have various origins. The most widespread among them are slide terraces, tectonic scarps and the terraces defined by deeply buried basement highs.

The origin of isometric and elongated elevations observed within the foot of the continental slope is not clear. One probable explanation is that they may represent the outliers of slump blocks cut by turbidity currents.

Debris cones that are typically expressed in the modern topography of the Arctic continental margins have not been detected. This may be explained by the activity of contour currents responsible for the distribution of sediments along the foot of the continental slope.

PALEOGEOGRAPHIC CHANGES IN DEEP-SEA ARCTIC BASINS AS INDICATORS OF THE MAIN STAGES OF THE CENOZOIC EVOLUTION

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The formation of the present-day morphostructural ensemble of the Arctic basin was to a large extent controlled by sedimentological pattern that was, in turn, strongly affected by the influence of the Atlantic and Pacific oceans. Recently obtained new seismic data suggest several major structural rearrangements in the region, the largest events occurring during the Oligocene and the Late Miocene. Paleozoogeographic and hydrological evidence of the connections between deep-sea basins and surrounding shelves are of crucial importance for paleotectonic and paleoenvironmental reconstructions.

Paleogene diatom assemblages from the Fram Strait constrain the evidence of continental shelf environments in water depths not exceeding 300-400 m. Freshwater diatoms are also common, indicating environments of coastal marshes. The analysis of ODP materials from the Fram Strait shows that in the Oligocene this basin was isolated from both the North Atlantic and the Arctic basins. During the Miocene, this basin became deeper and was characterized by higher sedimentation rates, thus providing favorable environments for the preservation of benthic agglutinating foraminifera assemblages. Apparently, this basin was at that time isolated from the Norwegian-Greenland Basin, as indicated by the absence here of the typical North Atlantic carbonate fauna.

On the Alpha Ridge, Cretaceous-Eocene siliceous-rich sediments are overlain by late Miocene-Pliocene deposits containing secretional fauna. This may indicate a fundamental environmental change that began in the Oligocene and reached its maximum during the Miocene. Further restructuring of the Arctic Basin was signified by the appearance in the

shelf and mainland sedimentary records of both the Atlantic and North Pacific fauna and flora assemblages and the onset of ice-house conditions imprinted in replacement of the Miocene thermophilic diatoms by cool-water species.

INTERANNUAL VARIABILITY OF SUMMER SEA-ICE THICKNESS IN THE SIBERIAN AND CENTRAL ARCTIC UNDER DIFFERENT ATMOSPHERIC CIRCULATION REGIMES

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The dominant sea-ice circulation pattern in the Eurasian sector of the Arctic Ocean is the Transpolar Drift (TPD), exporting ice from the Siberian shelves across the central Arctic Ocean into the Greenland and Barents seas. The present study focusses on the interannual variability of sea-ice thickness in the source area of the TPD and their relation to contrasting atmospheric circulation regimes.

Ice-thickness data sets were collected during icebreaker expeditions in the summers of 1991, 1993, 1995 and 1996 by electromagnetic induction measurements and drilling. Level-ice thickness varied considerably in the Laptev Sea, with modal thicknesses at the end of the melt season ranging between 1.2 and 1.9 m. Higher mean and modal thicknesses in 1993 and 1996 are associated with recirculation of first- or second-year ice over the Laptev shelf and severely reduced summer melt, both strongly influenced by the dominant spring and summer atmospheric circulation patterns. Low ice thicknesses in August of 1995, a year of a record minimum summer ice extent, are mostly the result of excessive surface melt, associated with advection of warm air from the Siberian continent. The thickness differences correspond to a large variability in ice extent and coverage. Both thickness and coverage can be explained by different strength and location of a cyclonic circulation area over the Central Arctic Ocean.

A Lagrangian thickness-evolution study and an analysis of the thickness and composition of level ice downstream in the TPD indicates that (level-)ice thickness anomalies tend to decay quickly as they are advected across the Arctic Basin due to both dynamic and thermodynamic processes.

RISING GAS BUBBLES IN SEDIMENTS - A MODEL FOR MIXING THE POREWATER

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Sediment cores retrieved from cold vent sites in the 'Obzhirov Flare' area (54°27' N, 144°05' E) northeast of Sakhalin, Sea of Okhotsk, show two types of remarkably different porewater profiles. While the first type mainly reflects the background situation of intense anaerobic degradation of organic matter, i.e. sulfate reduction and methanogenesis, the second type is related to upward fluid flow and the occurrence of near-surface methane hydrates (Biebow and Hütten, 1999; Biebow et al., 2000).

The first setting (cores LV28 20-2, GE99 26-2; Fig. 1) is characterized by high concentrations of NH_4^+, Br^- increasing with depth as well as SO_4^{2-} profiles which are declining rapidly to zero directly below the sediment-water interface. Due to high productivity and sediment input from the Amur River, in general, sedimentation rates are high (10-100 cm/ka), and microbial sulfate reduction of POC (about 1.2 to 1.8 wt%) consumes the dissolved sulfate totally between 2 to 3 m sediment depth (Fig.1). Simulations using a comprehensive transport-reaction model (C.CANDI, Luff et al. (2001)) show that a standard steady state early diagenetic approach can sufficiently explain the observed data.

In contrast, the products of organic matter degradation can only be found in low concentrations in the uppermost meters in the second setting (cores GE99 24-2, GE99 27-2, GE99 29-3). Similarly, the sulfate concentrations remain constant at the bottom water value in this uppermost sediment layer, before they decline to zero. As bottom water has to move downwards to produce these features, but fluid flow is generally directed upwards at

these stations, ascending methane gas bubbles, that lead to the observed methane plume in the water column, are proposed to generate a downward mixing of bottom waters.

In a first attempt, Aller's tube model for bioirrigation (1980) has been adopted to describe this phenomena assuming that the gas bubbles are rising (and thereby "instantaneously" mixing the pore water) on a much faster time scale than solutes are transported by diffusion and advection. A mixing rate of at least 0.1 a^{-1} is necessary to reproduce the observed data. The increased methane concentration at the lower model boundary, hereby, accounts for the higher methane flux from below due to upward fluid flow that is necessary to balance the increased sulfate gradient.

Acknowledgements
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TRANSPORT DYNAMICS ON THE LAPTEV SEA SHELF: TIMING OF SEASONAL PROCESSES AS A CONTROL FOR INTERANNUAL VARIABILITY

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Oceanographic, sedimentological, and biological processes on the Laptev Sea shelf exhibit a strong seasonality typical for arctic shelf seas. Extensive studies within the framework of the Russian-German research project "Laptev Sea System 2000" revealed an environmental system that is controlled by seasonal key processes that are active only during very short time periods. An outstanding example are the transport dynamics on the Laptev Sea shelf which are mainly controlled by atmospheric forcing, the ice cover, and the riverine input. The environmental conditions that prevail during the short phase in which the key processes are active predefine the transport processes and pathways during the rest of the year. The best examples for the coupling between the processes are the spring high flow of the Lena River in June and the freeze-up of the Laptev Sea in October:

On average the ice drift in the river mouth starts on June 3. During the following weeks the Lena River discharges about 50 percent of the annual input of suspended sediments to the still ice-covered Laptev Sea. Riverine dissolved and particulate substances are transported in a freshwater layer under the fast-ice of the Laptev Sea, thus estuarine processes like flocculation and rapid sedimentation are not active near the delta front of the Lena River. Instead the riverine suspended matter is transported far onto the eastern shelf. During the following weeks due to the sinking of particles the characteristic bottom nepheloid layer of the eastern Laptev Sea shelf is formed. The river-sea transport processes during June can show strong interannual variations because the dynamics of the spring flood and the extension of the fast ice in spring are controlled by short-term atmospheric processes that may vary from year to year.

In contrast to older models of sediment-loaded ice formation in the Laptev Sea, field investigations by means of seafloor observatories have shown that the winter polynya in the eastern Laptev Sea is not important for the formation and export of "dirty" sea ice. New investigations point to the conclusion that the short phase of the fall freeze-up, when ice starts to form in turbid coastal and inner shelf waters, is the predominant time period for the

shelf-to-basin transport of sediments by sea ice. During this phase most of the Laptev Sea is ice free, and newly formed ice fields can drift over long distances. Strong northerly winds during the second half of October may increase the turbidity of inner shelf waters and hence the particle content of newly formed ice. Subsequently, the dirty sea ice is transported northwards where it can be incorporated into the transpolar ice drift system. Thus the interannual variability of the important shelf-basin transport of sediments by sea ice is mainly controlled by atmospheric conditions that prevail during a short phase when newly formed ice fields are still mobile.

These examples underline that small changes in the interaction of physical processes during short phases can have a strong impact on the arctic shelf seas. The coupling of these processes is far from being understood. Therefore climate induced changes of the arctic marine environment will likely occur in surprising ways.

THE LATE QUATERNARY CLIMATIC AND ENVIRONMENTAL HISTORY OF NORTHERN CENTRAL SIBERIA – EVIDENCE FROM LAKE SEDIMENTS.

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Since 1993 extensive field and laboratory work has been carried out within the scope of the Russian-German research projects "Taymyr" and “System Laptev Sea 2000” in order to reconstruct the climatic and environmental history of northern Central Siberia since Early Weichselian time.

Our studies indicate that after a larger glaciation in the Early Weichselian, which covered almost the entire Taymyr Peninsula, most of the area remained ice-free during the Middle and Late Weichselian periods. The Middle Weichselian interstadial was characterized by a more continental and probably unstable climate than during the Holocene, with possibly higher summer but lower winter temperatures. The higher continentality could be due to an exposed arctic shelf as consequence of a lower sea level. The transition from the Late Weichselian to the Holocene is characterized by a clear climatic warming trend during the Bølling, Allerød and Preboreal periods, which is interrupted by cooling during the Middle and Younger Dryas events. In similarity to some intervals in the Middle Weichselian, the Holocene climatic warming resulted in enhanced thermokarst processes, leading to the formation of shallow lakes and ponds and subsequent peat formation.

Most of the lake sediment cores studied were used for quantitative paleoclimatic reconstruction using pollen and partly remains of aquatic organisms. Examples are presented for Lakes Lama and Levinson-Lessing from the Taymyr Peninsula and for Lake Nikolai located in the northwestern part of the Lena River Delta. A large set of AMS and conventional radiocarbon dates was obtained from the selected sequences in order to elaborate reliable age models.

Pollen records were used to reconstruct temperatures and precipitation with a temporal resolution between 100 to 200 years. Three statistical approaches, namely the information-statistical method, the Plant Functional Type (PFT) method and the best modern analogues (BMA) method have been applied to the pollen records from Lake Lama, Levinson-Lessing-Lake and Nikolai Lake. In addition, a quantitative paleoclimate reconstruction is carried out at Lake Lama using a transfer function based on a weighted average approach.

HYDROCARBON GASES AND GAS HYDRATES IN MUD VOLCANIC DEPOSITS OF THE BLACK SEA, THEIR COMPOSITION AND POSSIBLE SOURCES OF FORMATION

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Hydrocarbon (HC) gases and gas hydrates were collected in many localities of the deep Black Sea basin. The high HC concentrations were found to be related to mud volcanoes of different size, collapse structures and faults, which are well documented by seismic and acoustic methods. Mud breccia deposits, carbonate crusts, bacterial mats and local gas hydrate accumulations are closely associated with gas vents.

HC gases consist of methane (93-100%) and its homologues (C_2-C_5). The principle characteristics of the gases within the vent sites (abnormal high concentration in sediments, absence of correlation with total organic carbon (TOC) content in sediments, predomination of saturated HC over unsaturated ones, relatively low C_1/C_{2+} ratio etc.) suggest a termogenic origin of HC gases and their migration through the sedimentary section. The $\delta^{13}C$ value of methane varies from about –30 ‰ to -75‰ PDB. Such significant variations in $\delta^{13}C$ of methane clearly indicate a broad spectrum of mixed gases with a predominance of either termogenic or biogenic components.

Methane with a relatively heavy isotopic composition (from -32‰ to –56‰ PDB) corresponds to the largest mud volcanic structures with cone diameters of about 1 km and more. Depleted $\delta^{13}C$ in methane is characteristic for relatively small mud volcanoes (less than 500 m diameter) and vents along open faults.

By studying the isotopic composition of carbonate crusts from the same structures, two groups of carbonate crusts with $\delta^{13}C$ heavier than -20‰ and lighter than -40‰ PDB were distinguished, which are in concordance with the methane $\delta^{13}C$ in the corresponding structures.

The study of $\delta^{13}C$ of individual homologues from C_1 to C_5 from several vents and analyses of these data on the James diagram allowed us to conclude that the majority of HC gases occurred from organic matter with a level of organic metamorphism (LOM) between 8 and 9 that corresponds to the ”oil window” zone of the HC generation.

Rock clasts from mud volcanic breccia are represented mainly by clayey rocks of the Maikopian Formation (Oligocene – Lower Miocene). This formation is considered as a principal source of fluids in cold vents of the Black Sea. The kerogen from these rocks were studied with pyrolisis, which indicates a relatively low level of maturation between 5 and 8 LOM. These data confirms indirectly the main source of HC gas formation.

APPLICATION OF WAVELET ANALYSIS FOR STUDYING ZOOPLANKTON

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The use of ADCPs (Acoustic Doppler Current Profiler) has become a central issue in the study of biological and physical oceanography. Acoustic backscatter records from ADCPs have been used to characterize diel migration patterns and the patchy distribution of marine zooplankton.

One of the tasks of the fellowship project of the Russian-German Otto Schmidt Laboratory „Diel vertical migrations of zooplankton in the Laptev Sea shelf waters” was to analyze zooplankton distribution using wavelet transformation of ADCP data. A continuous wavelet-analysis allows to reveal non-stationary fluctuations when frequency and amplitude change with time. This method was successfully used to analyze ADCP records of current velocities and sea-level fluctuations. Weekly ADCP records of echo-intensity distribution at

station 11 (TRANSDRIFT VIII, September 2000) and yearly ADCP records from the oceanographic bottom stations "LENA" (73°27'N; depth 22m) and "YANA" (75°09'N, depth 44m), deployed on the Laptev Sea shelf during the period from August 1998 until August 1999, were analyzed by wavelet-analysis.

The yearly distribution of echo-intensity shows strong diurnal variations in the acoustic backscatter signal that is related to daily vertical migrations of zooplankton during two main periods of the year. The wavelet transformation of echo-intensity on 24-hour frequency allowed us to clearly establish the boundaries of these two periods (February-May and August-November) with a high intensity of backscatter signal fluctuations. The two intervals coincide with two active periods in the populations of common Copepoda species that have been previously recorded on the basis of long-term seasonal samplings. However, previous investigations have indicated that on the Laptev Sea shelf the active period in the zooplankton life cycle ends by the end of October–early November when the winter diapause starts. The wavelet transformation revealed that the active period is longer, lasting until the end of November–beginning of December. Wavelet transformation of the echo-intensity records of the "YANA" and "LENA" stations clearly demonstrates that, although daily zooplankton migrations follow similar patterns, they are more pronounced in deeper water ("YANA" station).

GLACIATION HISTORY IN NE SIBERIA - IMPLICATIONS FROM IRD AND STABLE OXYGEN ISOTOPE RECORDS

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The Sea of Okhotsk is a marginal sea of the NW-Pacific Ocean, which is characterized by strong variations in seasonal sea-ice coverage. It is considered as a relic of the last glacial, since today the sea-ice cover extends southward to even 43°N. Changes in oceanic productivity and terrigenous sediment supply are strongly driven by variations in sea-ice coverage.

In order to reconctruct ice drift patterns in the Sea of Okhotsk during Late Pleistocene-Holocene, we studied the lithological and granulometric composition of several cores. We defined the lithic debris >0.063 mm as an indicator for ice transport (Ice Rafted Debris, IRD). The accumulation rates of IRD serves to reconstruct the spatially varying ice cover through time.

The distribution pattern of ice-rafted debris in core-top sediments broadly reflects the modern sea-ice distribution during winter. In the western part of the Sea of Okhotsk, highest accumulation rates of IRD occur in line with the highest sea-ice abundances. The eastern part of the Sea of Okhotsk, however, is marked by low IRD accumulation rates. The intrusion of the relatively warm and shallow Kamchatka Current prevents an extended sea ice cover off Kamchatka even during winter times.

All recovered sedimentary records exhibit the continuous occurrence of IRD through time with strongly enhanced IRD accumulation rates during glacial periods. Due to the fact that large glacier systems ashore are missing today and even during glacial stages 2-4, we suggest (seasonal) sea ice to serve as the dominant transport agent to distribute IRD basin-wide. Sea-ice transport is most pronounced in the northern and western parts of the sea of Okhotsk, while being less established in the eastern part. This pattern of sea-ice drift seems to be relatively stable during stages 1-5.

During stage 6, instead, the main depositional center of IRD changed from the northwestern Sea of Okhotsk to the eastern part off Kamchatka. At the same time, accumulation rates of IRD increase significantly during stage 6 and are larger by a factor of 2 to 3 compared to the stage 2-4 IRD accumulation rates. The change in the depositional center of IRD together with stable oxygen isotope evidence leads us to speculate that IRD transport mechanisms changed considerably. During stage 6, large amounts of IRD are most likely transported by icebergs calving from the strongly glaciated Kamchatka Peninsula into the Sea of Okhotsk. Such assumption, in fact, needs to be supported by (still missing) age datings of onshore moraines.

INTERACTION BETWEEN CENOZOIC SEDIMENTATION PROCESSES AND TECTONICS IN THE OKHOTSK SEA: RESULTS OF THE KOMEX EXPEDITIONS

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During KOMEX cruises, the investigations were focused on regions of the Okhotsk Sea most important for understanding its tectonic structure and evolution – the Derugin and Kurile Basins. It is assumed that these two basins were formed as a result of rifting processes and that these regions suffered intensive extension in Oligo-Miocene. Seismic data of KOMEX cruises demonstrates that structural elements typical for crustal extension (basement tilted blocks) are widespread in the Derugin Basin and on the northern slope of the Kurile Basin. Numerous discrete structural basins were identified which are half-grabens bounded by dipping normal faults in the eastern Derugin Basin and on the northern slope of the Kurile Basin. Rift mountains are presented by tilted blocks. Adjacent half-grabens are often linked to each other. These linked half-grabens create basement depressions with typical dimensions of 40 – 50 km in the Derugin Basin and 15 – 25 km on the northern slope of the Kurile Basin. Some of the depressions appear as full grabens. The grabens are filled by sediments. Based on reflection configuration, the sedimentary section of the grabens was subdivided into three main units: pre-, syn -, and post-rift units.

In the eastern Derugin Basin, a major part of the sedimentary section is made up of syn-rift deposits. The syn-rift deposition started in Late Oligocene and stopped in Late Miocene – Early Pliocene. During the phase of rift development, when the rate of fault displacement was at a its maximum, subsidence outpaces sedimentation and differential relief is created across the fault scarp. Here, numerous normal faults are clearly recognizable in the bottom relief as scarps with heights of 200 – 600 m. During the syn-rift accumulation, tectonics, as opposed to eustacy, was the dominant factor controlling sedimentation. Then, in Early Pliocene, tectonics exerted indirect influence on the sedimentation as a result of the northern and central Sakhalin mountain ranges uplift.

On the northern slope of the Kurile Basin, syn-rift deposits comprise a lesser part of the sedimentary section (approximately one third of the total sediment thickness). It is assumed that the syn-rift deposition started in Late Oligocene and stopped in Early Miocene. The differentional relief created across the normal faults generally does not manifest in the sea bottom relief. This is not the case for the Academy of Sciences Rise, where numerous normal fault scarps with heights of 200 – 400 m create a complicated bottom relief. On the Academy of Sciences Rise, there is evidence that some tilted blocks were subaerially exposed up to Late Miocene. At present, the tops of these blocks are located at a sea depth of 1000 – 1200 m as a result of tectonic subsidence.

OTTO SCHMIDT LABORATORY FOR POLAR AND MARINE RESEARCH

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

Since 1993 bilateral research activities in the scope of the Laptev Sea System project include land and marine expeditions to the Laptev Sea and the Lena Delta during different seasons of the year, workshops, as well as the exchange of scientists. The GEOMAR

Research Center for Marine Geosciences in Kiel (Germany), the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven (AWI, Germany), and the State Research Center for Arctic and Antarctic Research in St. Petersburg (AARI, Russia) are jointly responsible for program coordination.

In October 2000, the successful collaboration was widely extended: the Otto Schmidt Laboratory for Polar and Marine Research (OSL) was opened in St. Petersburg, Russia. This project is part of a Cooperative Agreement on polar and marine research between the German Ministry for Education and Research and the Russian Ministry of Industry, Sciences and Technologies in order to promote the progress of science and closer collaboration between scientists and engineers of Russia and Germany as well as to support young Russian scientists in polar and marine research.

The OSL at the State Research Center for Arctic and Antartic Research is equipped with state-of-the-art standard laboratories for polar and marine research and an international library. The OSL fellowship program enables young highly qualified Russian scholars to carry out specific research projects in the scope of the interdisciplinary research program "Laptev Sea System 2000."

EFFECT OF GAS HYDRATE FORMATION ON THE GEOTHERMAL FIELD IN GAS-SEEPAGE AREAS

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The possible occurrence of geothermal anomalies caused by gas hydrate formation is related to two factors: to the significant thermal effect, resulting from phase transition which is higher than from water-ice phase transition, and to the difference between hydrate thermal conductivity and thermal conductivity of water and ice. Both factors can cause variations of the geothermal gradient different from the background value. No observational data of geothermal anomalies caused by gas hydrate formation and accumulation has been reported at present. Here, a theoretical study constraining the magnitude of possible thermal anomalies related to gas hydrate formation is presented. On the basis of available data on the seafloor gas-seepage area near Paramushir Island (Okhotsk Sea) and assuming different thicknesses of gas hydrate layers and physical properties of the sediments, the temperature and thermal gradient disturbances have been estimated for two models: for the water column near the sea bottom, in case the gas hydrate formation takes place directly under the seafloor; and for subbottom sediments, in case that the top of the gas hydrate layer is some meters below the sea bottom. These calculations show that the geothermal effect of gas hydrate formation is quite substantial. For the first model, calculations show that the bottom water temperature increases up to $0.01\text{-}0.1^0$C depending on the gas hydrate formation rate; for the second model, an anomalous subbottom temperature gradient is predicted of about 0.3^0C/m. It should also be noted that significant thermal effects caused by latent heat of hydrate dissociation must occur during gas hydrate decomposition: the temperature gradient above the gas hydrate layer has to be significantly less than normal steady-state ones. The results of these investigations suggest that a solution of the reverse problem is also feasible – estimations of the intensity of gas hydrate formations and the amount of forming hydrates on the data of investigations of the dynamics of the geothermal field.

SUBMARINE PERMAFROST ON THE LAPTEV SEA SHELF: EVOLUTION DURING THE MIDDLE PLEISTOCENE - HOLOCENE AND RECENT PROCESSES

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Permafrost on the Laptev Sea shelf (LSS) has been formed due to extensive regressions in the Arctic Basin during at least the Middle Pleistocene–Holocene. Since then his region has never been the area of glaciation. The main cause of transgression-regression cycles was the glacialeustatic oscillation of the sea level. For the reconstruction of paleopermafrost condition on the LSS isotopic curves, obtained from Antarctica, were used.

Mathematical modelling of permafrost dynamic on the LSS was carried out. For the calculations software developed by G.S. Tipenko was used.

The model takes into consideration the latitudinal permafrost zonality, the duration of aggradation and degradation of permafrost and the spatial variability of geothermal heat flux. Calculations for the last 4 climatic cycles (400 kyr.) were carried out.

On the base of the results of the calculations the following conclusions can be drawn.

On the main part of LSS (up tothe recent isobath of –45m) permafrost has permanently existed at least since 400 kyr BP. On the middle part (from –45 to –80 m isobath) a complete degradation of permafrost during transgressions took place only in the active fault zones with high values of geothermal flux. Only on the outer part of shelf (deeper than 80 m.) a complete degradation of permafrost during the transgressions took place everywhere.

During the stages of regressions on the exposed shelf, ice-bonded permafrost with thick (600–700 m near the recent coast and 300–400 m near the edge of the shelf) was formed. Within a short time (3-5 kyr) after the flooding of the site of shelf, the warming and degradation of permafrost happened. Degradation takes place predominantly from below due to geothermal flux. Ice-bonded permafrost was replaced by ice-bearing one.

Nowadays permafrost still exists in degradation state. Ice-bonded permafrost occurs only in a narrow belt along the recent coastline and on the shallow banks at the sites of former islands, composed by “Ice Complex” and destroyed by thermoerosion.

The recent thickness of permafrost is about 500 m near the north coast of Kotelny Island, 300–350 m near the continental coast and 100 m and less on the outer part of the shelf.

Nowadays processes of active seafloor thermoerosion with a rate of 0.5-0.3 m per year take place on the shallow banks which replace eroded islands.

DELAY IN ICE FORMATION ONSET IN THE LAPTEV SEA: CONSEQUENCE OF ADDITIONAL HEAT FLUX FROM THE BOTTOM LAYER

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During the summer season under the ice-free conditions in the Laptev Sea a large amount of heat accumulates in the water column. Its influence on the further fall cooling and freeze-up processes has been described before by many authors. But it was suggested that strong density interface prevents the transport of the heat accumulated below the pycnocline upward to the surface layer. However, multi-diurnal ADCP records carried out during the summer Russian-German expedition TRANSDRIFT VIII in 2000 reveal the existence of the internal gravity waves, whose instability results in wave breaking and intensification of vertical heat exchange through the pycnocline. Thus, the thermal regime of the upper and bottom water layers is strongly affected by these processes. Two different approaches were applied to estimate heat flux intensity and to define the freeze-up onset delay. The first is based on the parameterisation of the internal gravity waves mixing from original current and buoyancy profiles. The second is used to define the spatial variability of the vertical heat fluxes through heat balance estimation in the upper water layer. The daily passive microwave images (SSM/I) of the Laptev Sea surface during the freeze-up onset, CTD data obtained in several cruises and meteorological data provided by NCEP/NOAA

Climatic Diagnostics Center were examined to evaluate the discrepancy of the heat balance due to underestimated turbulent heat fluxes from below.

It was found that the current velocity shear closely is traced to the shear of the Garrett and Munk model for open ocean conditions. The diapycnal diffusive coefficient as well as vertical heat flux values in the pycnocline were calculated, both methods producing similar results. These fluxes could result in the freeze-up onset delay up to several days. The zones of maximum heat exchange intensity coincide with the areas influenced by river runoff.

THE WATER COLUMN STRUCTURE IN THE BERING STRAIT

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The Chukchi and Laptev seas are complex but different systems. The water column structures of the seas are formed by different physical, chemical, and biological processes. The Laptev Sea is under the influence of river runoff. The Chukchi Sea is under the influence of the Pacific Ocean Waters, entering through the Bering Strait. The inflow of the Pacific Waters is approximately ten times higher than the total river runoff in the Arctic. But there are some common features, which are determined by their high latitude location, severe climatic conditions, and an almost permanent ice cover.

The Bering Strait is a key area for the understanding of the structure, dynamics, water transport of the Chukchi Sea. The high nutrient inflow with Pacific waters entering through the Bering Strait greatly influences the processes both in the Chukchi Sea and in the Arctic Ocean. We need in new investigations of this region because of the development of a new conception of the water column structure.

The main objective of this presentation is to show the results of long-term observations in the Bering Strait. The Ocean Data View software (Schlitzer, 2001) was used for data visualization. The great experience in hydrochemical investigations obtained in the multidisciplinary research program “Laptev Sea System” was used in our research.

ATMOSPHERIC INPUT OF TRACE METALS INTO THE LAPTEV SEA

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As we know from the studies of the last years the atmospheric input of natural and anthropogenic tracers to the Arctic Ocean can be about 10% of the total particulate matter input. And from another side as a result of synoptic and meteorological conditions the arctic air can get an anthropogenic input (such as heavy metals) from different regions (Europe, Siberia, North America for example).

Using data from the Russian Center for Hydrometeorology new five-day-traveltime forward and back trajectories of air masses were calculated and constructed for the central part of the Laptev Sea. These trajectories were calculated for 10 years from 1986 to 1995 for each season of the year.

We have got three main pathways of tracers into the Laptev Sea:

a) from continents (Europe, Asia, North America);

b) from the Atlantic Ocean and Pacific Ocean;

c) from the arctic region.

Comparing these trajectories with estimations of emission data from literature and with experimental data from this region we can estimate the impact of each source-region during all the year. We see that during summer and fall these impacts are less than in winter and spring. There are some reasons for this situation. The movement of the boundary of the Polar Front to the south in cold seasons is one of these reasons. The decrease in quantity of precipitation in cold seasons and as a result of this decrease in the rate of sedimentation of matter is another reason.

We analyzed source-region contributions to air pollution by some elements and emission data. Urals and Kuznetsk have maximum emission values, Norilsk gives maximum contributions to air pollution in the Laptev Sea region. Different distances from source region and some features of atmospheric circulation are responsible for this. All our data correlate well with the literature data averaged for 15 years at Alert, Canada.

Our work was financially supported by the German and Russian Ministries for Science and Technology within the framework of the Otto Schmidt Laboratory fellowship and "Laptev Sea 2000" project.

METHANE PRODUCTION IN SIBERIAN TUNDRA SOILS: INFLUENCE OF TEMPERATURE AND SUBSTRATES

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The methane production of a vertical profile of a Siberian tundra soil was studied in dependence on different substrates (glucose, acetate, H_2/CO_2) and under increasing temperatures (from 0°C to 52°C).

The methanogenesis increased in all horizons with increasing incubation temperature up to approximately 37°C. Nevertheless, even at low temperatures between 0°C and 17°C a significant methane production was observed. No methane production was measured at temperatures higher than 47°C.

The methane production in the various horizons showed a different response to the incubation temperature and additional substrates. In the upper horizons the maximum methane production rate was reached at a lower temperature than in the underlying horizons. Furthermore without any additional substrates and after adding glucose to the samples the surface horizon showed the highest production rate, but after the addition of acetate or H_2/CO_2 the production rates in the deeper horizons were higher than in the surface horizon.

By using the FISH-technique we could find organisms of the orders Methanobacteriales, Methanomicrobiales and Methanosarcinales in the surface horizon but in the deeper horizons we could only find organisms of the order Methanosarcinales. Because of the obtained results we conclude that different methanogenic populations were responsible for the methane production in the different horizons.

METHANE CONTENTS IN DIFFERENT COMPARTMENTS OF THE LAPTEV SEA – PRELIMINARY RESULTS

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Within the framework of the project "Laptev Sea System 2000" the first investigations of the methane cycle were started in the Laptev Sea. The aim of the study was to estimate the possible role of the Laptev Sea region for the methane budget. During the expeditions TRANSDRIFT V in 1998 and TRANSDRIFT VI in April 1999 samples were taken at 9 bottom, 30 water, and 12 ice stations. The occurrence and distribution of methane in the marine water column and in the seasonal ice cover of the Laptev Sea were investigated as well as the microbiological methane production in the sediment of the Laptev Sea.

The sediment samples showed no methane production activity in the upper 3 meters. Between 3 and 6 meters the methane production increased drastically with maximum rates between 3 and 4 nmol h^{-1} g^{-1}. This is a relatively high methane production in relation to the low *in situ* temperatures. Methane production in the sediment is one reason for the methane accumulation in the water column of the Laptev Sea.

Most of the water profiles showed higher methane contents than the atmospheric equilibrium (~4 nmol l^{-1}), at least in some depths. Some profiles had the highest methane content near the bottom (up to 70 nmol l^{-1}), others near the surface (up to 20 nmol l^{-1}). It is assumed that these differences in the methane distribution were caused by the varying

influence of the microbial processes and possible different sources of methane (methane production in the water column, methane fluxes from destabilized gas hydrates, influence of the Lena inflow) at the different investigation sites.

Compared to the water samples we could find an enrichment of methane in all ice samples. The average value for the ice samples was 1563 nmol l^{-1}. This value is about 100 times higher than the average value of the surface water. This could be explained by the interrupted water-atmospheric exchange during the ice cover. Two samples showed methane concentrations above 437 µmol l^{-1}. One explanation for these extremely high values could be an *in situ* methane production in the sea ice.

Due to our measurements we conclude that during the ice break in spring not only the stored methane of the water column will be released into the atmosphere but also the methane which is enclosed in the ice sheet. To our knowledge this potential source of methane is not considered in recent models of the marine methane cycle.

HOLOCENE VEGETATION CHANGE AND AMUR RIVER RUN-OFF BASED ON THE ANALYSIS OF POLLEN, SPORES AND CHLOROCCACALEAN ALGAE IN CORE LV28-4-4 FROM THE SEA OF OKHOTSK

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Pollen, spores and chlorococcalean algae were studied microscopically in core LV28-4-4, which was recovered from the continental margin off NE-Sakhalin in the Sea of Okhotsk (51°08.475N, 145°18.582E, 674 m water depth). The study was performed in order to reconstruct vegetation changes of the adjacant Siberian hinterland and to examine whether run-off events of the Amur River are detectable on the basis of chloroccacalean algae. These algae usually live in fresh water, and their occurrence in the marine environment therefore reflects the discharge of the Amur River to the Sea of Okhotsk. Since it was previously shown that the modern distribution pattern of pollen and spores in the Sea of Okhotsk sediments closely resembles the distribution of vegetation units on the adjacant land (Koroneva 1957), we adopt this approach to reconstruct regional vegetation changes through time.

The age model for the 930 cm long core LV28-4-4 is based on 16 AMS^{14}C-datings of benthic and planktonic foraminifera and bivalvia. The sedimentation rate varies from 20 cm/k.y. during glacial times to 125 cm/k.y. within the late Holocene interval.

Four pollen zones were distinguished on the basis of the present micropaleontological data. Pollen zone I (12,600-11,800 years BP), which comprises the Younger Dryas event, was dominated by non-arboreal taxa such as grasses (gramineae) and sedges (cyperaceae).

The following pollen zone II (11,800-8,500 years BP) was in general dominated by birch (*Betula*) and elder (*Alnus*). The rise of spruce (*Picea jezoensis* and *P. glehnii*) dominated taiga is clearly to be seen at the end of this zone and shows the preboreal warming. The oldest part of pollen zone II is very distinct with high values of birch and spruce and very low values of gramineae and cyperaceae and suggests a period of intense warming. This is supported by a peak in chloroccacalean algae (*Pediastrum* spp. and *Botryoccocus* cf. *braunii*), but as the interval still consists of only one sample, high resolution studies are needed to outline possible rapid climatic events inferred from the data. Pollen zone III (8,500-3,600 years BP) is dominated by darkneedled taiga components and increased oak (*Quercus*) values and reflects the Holocene climatic optimum. The latest pollen zone IV beginning 3,600 years ago shows a renewed decrease in the relative abundance of oak as well as increased values of pine, which indicates a general cooling of the climate in the region.

A distinct Amur fresh water pulse is recognized in the algae accumulation rates at 10,500 years BP. This event is also recognized in the oxygen isotopes and in the C/N ratio (see Kozdon et al., this volume) and is interpreted as the Termination Ib.

A HIGH RESOLUTION HOLOCENE GEOCHEMICAL RECORD FROM THE SEA OF OKHOTSK - IMPLICATIONS FOR CLIMATE CHANGE IN THE SIBERIAN HINTERLAND

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This study attempts to reconstruct paleoenvironmental changes in the Sea of Okhotsk during Holocene on very high temporal resolution. Today, the Sea of Okhotsk, a marginal basin of the NW-Pacific Ocean, turns into an area of extremely high marine productivity during the ice-free period from June to November. This especially holds for the coastal areas off Sakhalin Island, which is a region of high sedimentation rates caused by significant terrigenous and nutrient supply via the Amur River. The Amur fresh water inflow significantly affects the surface oceanography. It enters the Sea of Okhotsk at the northern tip of Sakhalin and bounds to the south mainly due to the anti-clockwise gyre that characterises the circulation pattern of the Sea of Okhotsk.

Core LV28-4-4 recovered from the high-sedimentation area of the eastern slope of Sakhalin is directly lying under the influence of the Amur outflow. The 930 cm long gravity core (51°08.475N, 145°18.582E, 674 m water depth) spans approximately 15,000 years as inferred from the robust age model calculated from 16 AMS ^{14}C - datings. The resulting sedimentation rate varies from 20 cm/k.y. during Younger Dryas to 125cm/k.y. within the late Holocene interval.

High-resolution geochemical studies with 1-5 cm-spacing (elemental XRF-scanning, biogenic opal, carbonate, organic carbon, planktic and benthic oxygen isotopes) were performed in order to gain background information about the Holocene depositional evolution.

Our studies reveal that sediments are dominated by only two components, biogenic opal and siliciclastics. Together, they amount to 97-98.5 % of the total sediment. Hence, the long-term increase in biogenic opal from less than 5% in Younger Dryas to about 45% during Holocene is paralleled by a decrease of the siliciclastic component mainly due to dilution effects. The observed change in terrigenous matter composition, instead, is subject to both variations in the Amur River run-off and fluctuations in the concentration of particle matter. Therefore, core LV28-4-4 provides ultra-high resolution information on Holocene climatic variations in the Amur drainage area which covers about $1.72x10^6$ km^2 in east Siberia.

The Al/Ti-ratio, a common parameter for the classification of sediments, eolian dust and rocks, decreases distinctly from 15,000 to 8,000 years B.P., but remains constant during the last 8000 years. Similarly, the content of coarser particles (125-500 µm) decreases, implying pronounced changes in the source region and/or in the mechanisms of sediment transport and deposition.

The comparison of the K/Ti-record with the oxygen isotope climate record of the Greenland GISP2 ice core shows an excellent overall correlation. Most prominent is the simultaneous termination of Younger Dryas in both records, as well as the short-term cooling event at 8,200 years B.P. which was induced by a massive fresh water outflow from the Hudson Strait. The comparison of Holocene periodicities and wavelet-analyses of the K/Ti-ratio with the GISP2 oxygen isotopes shows strong similarities pointing to the existence of an atmospheric teleconnection between the east Siberian drainage area and climate variations documented within the Greenland GISP2 ice core.

POSTGLACIAL CLIMATE AND VEGETATION HISTORY OF KOLA PENINSULA, RUSSIA

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Palynological studies of lake and peat sediments, *Pinus sylvestris* macrofossil dating and stable isotope analyses provide data on vegetation and climate history of the area since the deglaciation.

11,000-10,000 years BP, birch forest tundra was a dominant type of vegetation in the southeast of Kola Peninsula, while tundra was spread in the north. Birch- dominated forests were spread over the peninsula in the Early Holocene. *Pinus sylvestris* had expanded on Kola Peninsula since 9,000 years BP, and 8,000 years BP it reached its present northern limit.

Pine expanded beyond its modern northern limit between 7,000 and 3,500 years BP. The most dense pine forest existed between 6,500 and 5,500 years BP. The position of many samples indicates a lower lake level between 6,200 and 4,400 years BP. The stable isotope analysis suggests the mid-Holocene climate having been warmer and drier than the modern one. Birch forest tundra expanded up to the Barents Sea shore.

5,000 years BP, the tundra vegetation expanded in the north of Kola, and 3,500 years BP, the tundra belt reached its present-day shape.

About 5,500/5,300 years BP, *Picea obovata* penetrated the central part of the peninsula, and 3,500 years BP, spruce reached its modern northern limit.

1,000-800 years BP, in the central part of the peninsula pine grew 100-120 m above its modern limit. Stable isotopes indicate higher summer temperatures. The lake level was low, and the avalanche activity seriously decreased.

Data from Kola Peninsula is in good agreement with the Holocene reconstruction of the sea surface temperature in the Barents Sea and with the previously established vegetation history in northernmost Fennoscandia.

QUATERNARY PALEOCEANOGRAPHY OF THE MENDELEEV RISE, AMERASIAN BASIN OF THE ARCTIC OCEAN.

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In 2000 VNIIOkeangeologia and PMGRE carried out a cruise to the Mendeleev Rise area (Amerasian Basin, Arctic Ocean) onboard MV "Akademik Fedorov". 40 geological stations were occupied. The gravitational tube and small grab corer were used. The maximum length of extracted gravity cores reached 335 cm.

Five cores from the top and slopes of a local bottom elevation in the central Mendeleev Rise were investigated in detail. Paleomagnetic investigations, grain size and mineralogical analyses were carried out. Ostracodes, planktic and benthic foraminifers were determined.

The Bruhnes, Matuyama, and Gauss epochs (the latter in one core) were established on the basis of the paleomagnetic data. These determinations implied extremely low sedimentation rates on the order of the first mm per thousand years.

We offer an alternative age model based on the identification of calcareous nannofossils and the fluctuations of the abundance of planktic foraminifers. The coccoliths *Emiliania huxleyi* were determined in one core at levels 10 and 40 cm corresponding to 1 and 5 OIS. Taken together with the vertical distribution in the cores of foraminifers indicating alternating warm and cold periods, these data suggest that the cored interval does not extend below the Bruhnes epoch. Consequently, sedimentation rates appear an order of magnitude higher than derived from paleomagnetic evidence.

QUANTIFYING METHANE EMISSIONS FROM SIBERIAN PERMAFROST LANDSCAPES: THE EDDY COVARIANCE TECHNIQUE AS A TOOL TO DETERMINE TRACE GAS FLUXES ON THE ECOSYSTEM SCALE

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When quantifying CH_4 emissions from permafrost landscapes, two major problems have to be considered: (1) Although very homogeneous on the large scale (100 m to 100 km), permafrost ecosystems are highly diverse on the small scale (0,1 m to 10 m) due to cryogenic processes in soils. This results in a very high spatial variability of CH_4 emission on the small scale (1.8 to 80 mg m^{-2} d^{-1} within 5 m); (2) CH_4 emissions of permafrost ecosystems show a high temporal variability caused by the extreme arctic climate.

As a direct approach to cope with these problems, an eddy covariance measurement system will be installed in the central Lena Delta, Northern Siberia, in summer 2002. The system will simultaneously determine flux values of CH_4, CO_2, H_2O, sensible heat, and momentum representative on the ecosystem scale. The advantages of the eddy covariance technique are: (1) It inherently averages the small-scale variability of CH_4 emission over a surface area that increases with measurement height; (2) measurements are continuous and in high temporal resolution; (3) fluxes are determined without disturbing the surface being monitored.

Applying the micrometeorological eddy covariance technique, concurrent instantaneous measurements of the vertical wind velocity and a scalar quantity, such as CH_4 concentration, are correlated to obtain the flux. The measurement system must provide fast-response (10 Hz) and highly sensitive measurements of trace gas and vertical velocity fluctuations at nearly the same point in space. The technical set-up of the measurement system includes the following instruments: (1) a three-axis sonic anemometer, (2) an infrared CO_2/H_2O analyzer, and (3) a CH_4 analyzer based on tunable laser infrared spectroscopy. All signals will be digitized at 10 Hz by the anemometer and stored and reprocessed on a portable PC.

The eddy covariance CH_4 flux data will be evaluated in comparison to closed-chamber flux measurements of CH_4 which were conducted in the Lena Delta in the years 1998 to 2001 within the framework of the project "Laptev Sea System 2000" and will be continued in summer 2002 parallel to the eddy covariance measurements. The projected measurement campaign will make available the first data of ecosystem-representative CH_4 fluxes for permafrost landscapes of the Siberian Arctic. This kind of data is necessary for the improvement of soil-vegetation-atmosphere models able to assess the impact of climatic change on arctic ecosystems.

DETAILED RECONSTRUCTION OF THE LAPTEV SHELF LAND ENVIRONMENT AND CLIMATE DURING THE LAST 50,000 YEARS - MAMONTOVY KHAYATA REVISITED

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In 2001 a Russian team continued the study of Mamontovy Khayata, the key section of Ice Complex in the Lena Delta (Bykovsky Peninsula), where the earlier (1998-99) fieldwork under the Russian-German project ”Laptev Sea System 2000” provided the most detailed, continuous and well dated record of the past environment of the Laptev Shelf Land during the last 50 ka (Sher et al., 2001; Schirrmeister et al., 2002). The aim of the 2001 fieldwork was to fill some sampling gaps in the section, especially in the late Karginian and Sartanian sequences, and at the Pleistocene/Holocene transition, and to try to increase the resolution of the record. For the first time, most samples were taken not from the thawed sediment on the slope, but chopped from permafrost, which allows more precise stratigraphic control and minimizes possible contamination. In total, 23 samples were screened for fossil insects, mostly from the upper part of the section. At the same time, general samples (for pollen, ^{14}C dating, etc.) were taken, as well as additional samples for oxygen isotope analysis from ice wedges.

The main conclusion of the preliminary analysis of the 2001 insect assemblages is that the new sampling confirms the earlier recognized pattern of environmental change (Sher et al., 2001), which is a good indication of high reliability of the method, and adds some additional details to it. The late Karginian insect assemblages, in line with previous results, indicate a relatively cold and dry climate with low summer temperature. They are usually dominated by xerophilous tundra species, such as ground beetles *Curtonotus alpinus*, *Pterostichus (Lyperopherus) sublaevis*, weevils *Mesotrichapion wrangelianum*, *Hemitrichapion tschernovi*, and *Sitona borealis*; very important is the share of arctic insects (weevil *Isochnus arcticus*).

Fully confirmed is the earlier suggested recognition of two different climatic intervals within the Sartanian stage: the earlier, with the sharp dominance of the arctic weevil *Isochnus arcticus*, indicating a very cold environment, and the later, characterized by typical tundra-steppe conditions (evidenced by the presence of steppe species and dominated by the pill-beetle *Morychus viridis*). However, the beginning of the late Sartanian "warm" interval should most likely be shifted to a later time (from previously suggested 18 ka to about 14 ka). A very short-termed episode of warmer summers was found inside the "cold" Sartanian interval (corresponding to the Last Glacial Maximum). The section interval from which this anomalous sample comes requires further study.

The Early Holocene insect assemblages are sharply different from the late Sartanian ones. In 2001, we traced the boundary between the Pleistocene and Holocene deposits in the Mamontovy Khayata main section to a greater detail. It runs at the depth about 2 m. The gray silt member below it, like the Sartanian sands further down, turned out to be dominated by *Morychus viridis* and to include fossils of meadow-steppe (*Coniocleonus cinerascens, C. astragali)* and steppe (*Stephanocleonus eruditus*) species, thus portraying a typical tundra-steppe environment. The brownish-gray silt with peat inclusions above 2 m is dominated by the mesic tundra ground beetles *Pterostichus (Cryobius) brevicornis* and includes thermophilic species, such as the ground beetles *Blethisa catenaria, Diacheila polita, Elaphrus sp., Trichocellus mannerheimi*, the carrion beetle *Blitophaga opaca*, the rove beetle *Philonthus sp*., the leaf beetles *Chrysomela blaisdelli*, the ant *Camponotus herculeanus*. The assemblage indicates an environment similar to the modern southern shrub tundra or forest-tundra, and a climate warmer than the present one. Such a striking change in faunal composition confirms the existence of a break in sedimentation, earlier suggested by radiocarbon dating as 3-4 thousand years long. Our previous statement on the smooth transition between the Pleistocene and Holocene beetle fauna should be abandoned as it was most likely based on a mixed sample, which was taken in 1998 at the boundary and included sediment from both above and below it.

The new results cast additional light on the peculiar history of the Laptev Shelf Land environment in the Late Pleistocene. The precise correlation of the new samples with the previously taken ones should be confirmed by additional AMS ^{14}C dating.

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PLEISTOCENE AND HOLOCENE MAMMALS, INSECTS AND DEPOSITS OF THE LENA DELTA REGION (OLENYOK CHANNEL)

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Paleontological investigations were part of the multidisciplinary research of the Late Quaternary deposits at the Olenyok Channel within the framework of the Russian-German project “Laptev Sea System – 2000”. They include the collecting and research of large and small fossil mammals and insects. We studied two exposures at the channel - Nagym exposure (Ebe-Basyn-Sise Island) and Buor Khaya exposure (Kurungnakh Island).

All of the bones and fragments found were registered in order to obtain statistics of species composition as complete as possible. The most numerous samples belonged to the woolly mammoth (40%), followed by horse (19%), hare (15%) and reindeer (15%). This collection describes a typical complex of herbivorous mammals, however the proportion of the species differ from the mammal bone collection from Bykovsky Peninsula and Bol’shoy Lyakhovsky Island. This collection has the highest percentage of mammoth and hare bones.

The Lena Delta is an interesting region for paleoentomological research because it is situated between two paleogeographic areas. East of the Lena Delta xerotic tundra-steppe Pleistocene insect complexes were found and west of the Lena Delta xerotic or mesic tundra ones. 15 samples had been screened for insects and small vertebrates: 11 samples from the Nagym exposure and 4 samples from the Buor Khaya.

The lower parts of the cliffs are provisionally named Bulukur-Suite. According to the insect remains these sandy deposits can be divided into two parts. The lower part is sandy series with many vertically orientated grass roots and allochthonous pieces of peat with narrow and short ice wedges. This part does not contain a lot of insect remains and fly insects *(Hymenoptera)* are predominant. The composition of fossil insects from the lower part of Bulukur-Suite indicates environmental conditions close to those of nowadays or a bit warmer. Tundra steppe elements are typical for the Pleistocene deposits of northeastern Siberia but they absent here. The predominance of fly insect remains in the samples can be explained by the conditions of sedimentation. Probably, these deposits belong to alluvial sediments, flood plain facies and formed on wide wet low ground.

The upper part of Bulukur-Suite is a sandy series with isolated plant detritus with narrow short ice wedges. The insect complex from the upper part of Bulukur-Suite differs strongly from the previous one. It consists of various forest species such as ants (*Camponotus herculeanus, Formica sp*.), weevils (*Hydrobius fuscipes, Pissodes sp*.), and bark beetle (*Ips cembrae*). This complex indicates the environmental conditions of the taiga.

The Holocene deposits are divided into a silty-sandy series with peat inclusion, paleosoils, wood, with narrow ice wedges of several generations and an alluvial sandy series with allochthonous peat horizons - terrace facies. The insect complex from the first type of deposits is typical for tundra forest conditions. It consists of the remains of mesic tundra species and several forest species, for example, bark beetle *(Polygraphus sp*.). But dominant inthis complex is a typical bog species - the rove *Olophrum consimile*. The insect complex from the terrace facies indicates the environmental conditions of the taiga.

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GEOLOGICAL MAP OF THE OKHOTSK SEA FLOOR

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The map has been compiled on the basis of studying the matter composition and age of the basement rocks and sedimentary coverusing a wide range of of geophysical data (gravity data, magnetic data and single channel seismic reflection method). Thereby, materials obtained within the KOMEX project were used, as well as data collected by predecessors.

In the Sea of Okhotsk, the upper part of the Earth's crust is subdivided into the acoustic basement and the overlapping Cenozoic sedimentary cover.

The rocks of the folded (acoustic) basement are exposed in the central part of the sea: on the Kashevarov Swell, Saint Iona Swell, Institute of Oceanology Rise, Academy of Sciences Rise, on the slopes of the Okhotsk Arch, which are isolated fragments of the Okhotsk Sea Plate. They are represented by sedimentary, magmatic and metamorphic formations of different composition and age.

The Paleozoic complex (313 Ma) includes metaeffusives, phyllites, gneiss, amphibolites and schists.

Mesozoic deposits are represented by sandstones, aleurolites and clayey schists, sometimes with Upper Triassic and Cenomanian-Turonian fauna.

Mesozoic magmatic rocks are represented by effusive and granitoid formations. Among the last ones, there are diorites, granodiorites, granosyenites and granites of the Late Jurassic (179-138 Ma), as well as Cretaceous (138-72 Ma) diorites, granodiorites, granites and gabbro.

Volcanogenic rocks are subdivided into a series of age complexes. Among the Mesozoic ones, a Late Jurassic complex (179-142 Ma)was distinguished represented by andesite-basalts, andesites, andesite-dacites, an Early Cretaceous (130-97 Ma) complex with basalts, andesites, andesite-basalts and a Late Cretaceous (96-69 Ma) one with rhyolites, rhyodacites, their tuffs and ignimbrites.

On some rises, Cenozoic volcanogenic rocks are developed, among which, according to radioisotope data, we distinguish: an Eocene complex (51-37 Ma) composed by basalts, andesites, and andesite-dacites; an Upper Oligocene one (25 Ma) represented by andesites; a Middle Miocene one (11.9 Ma) composed by basalts, and a Pliocene-Pleistocene complex (4.1-0.93 Ma) represented by basalts, andesites, andesite-dacites.

The deposits of the sedimentary cover are studied sufficiently only in the shelf part of the sea by numerous boreholes. In the rest of the area, the Cenozoic deposits outcrop from underneath the recent deposits on the particular steep slopes of the rises. On the basis of paleontological data, we can distinguish here Upper Paleocene - Lower Oligocene argillites; Upper Oligocene - Lower Miocene tuffaceous diatomites, diatomites, aleurolites; Lower-Middle Miocene tuffaceous diatomites, diatomites, aleurolites; Upper Miocene - Pliocene diatomites, tuffaceous sandstones, aleurolites; Pliocene tuffaceous diatomites, tuffaceous aleurolites, diatomites; Pliocene-Pleistocene tuffaceous diatomites, tuffaceous sandstones, argillites. The Upper Quaternary recent deposits are represented by gravelly-pebbles, sands, silts, pelites and mictites.

The Okhotsk Sea Plate is a complex system of Paleozoic-Mesozoic blocks formed in Late Cretaceous. The subsequent Cenozoic riftogenesis caused the destruction of some parts of the plate, the separation of its integral basement, and the development of faults, where the riftogenic troughs, grabens and basins originated, they were filled up by Cenozoic marine deposits.

BENTHIC FORAMINIFERAL $\partial^{13}C$ ANOMALIES IN GRAVITY CORE GE 99-24: EVIDENCE FOR EXTREME HOLOCENE PALEOMETHANE ANOMALIES OFF NE SAKHALIN?

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Core GE99-24 was recovered from the continental margin off NE-Sakhalin presently known as the „Obzhirov Flare“ methane-venting area at a water depth of 700 m. Initial analysis of stable carbon isotope data from benthic foraminifera revealed extreme negative excursions in $\partial^{13}C$ signals of both epi- and endobenthic foraminifera being hitherto inexplicable by usual background water mass signatures. Epibenthic foraminifera record the $\partial^{13}C$ signature of the $\sum CO_2$ of surrounding bottom water masses, while endobenthic species primarily reveal ambient pore water $\partial^{13}C$ values. Our initial results reported maximum values as negative as –18 ‰ (all vs. PDB) for endobenthic and –31‰ for epibenthic species in a late Holocene (3000-1000 yr b.p.) section of the core.

To circumvent the problem of being possibly misled by alterations of the primary signal due to early diagenetic processes, we further evaluated our first measurements by conducting a series of isotope measurements on selected specimen of U. peregrina, U. auberiana and Cibicidoides spp. from three specific core depths with maximum $\partial^{13}C$ excursions. Selected specimen were therefore divided into subsequent stages of alteration due to dissolution and secondary encrustation. Single shells were carefully crushed and underwent multiple cleaning procedures until almost translucent shell fragments were obtained. Analysis of these fragments for $\partial^{13}C$ and $\partial^{18}O$ was carried out for each different stage of preservation and possible contamination. The work was accomplished by inspection of selected retained foraminiferal fragments under SEM to detect possible alterations of shell ultrastructure. Fragments were compared to specimen proven to be unaffected.

Our overall results show a relatively wide scatter within single sample depths. $\partial^{13}C$ values range from –1.5 ‰ down to –18 ‰ with data points scattered quite uniformly over the entire range. These are neither significantly correlated to miscellaneous stages of shell preservation nor to potential rests of dirt attached to original shells. So far SEM observations have revealed no palpaple alteration of shell ultrastructure corresponding to specific negative values of single specimen. Thus it appears reasonable to presume these results to be primary signals and assign them to past extreme methane anomalies in our study area. So, most probably, our $\partial^{13}C$ values indicate extreme CH_4-venting events or increased oxidation of CH_4 to CO_2 beyond sediment surface in bottom water masses. The observed scatter within our measurements could be mainly attributed to high variability of the liable processes and therefore to a lack of temporal resolution in our sampling intervals.

SEA-ICE CHANGES IN THE OKHOTSK SEA AND ITS PALEOCEANOGRAPHICAL CONSEQUENCES DURING LAST GLACIATION-HOLOCENE; EVIDENCE FROM ICE RAFTED DEBRIS AND DIATOM

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In order to study sea-ice coverage changes in the Okhotsk Sea, combined studies of ice rafted debris (fraction >0.15mm) and diatom species were carried out on thirteen sediment cores from different parts of the sea.

The oxygen-isotope records, radiocarbon AMS data, carbonate and opal stratigraphy, sediment magnetic susceptibility, on-board visual description, tephrachronology and paleontological results were used to obtain a detailed sediment stratigraphy and an age model of the studied cores.

As a result, three schemes of the IRD accumulation rate for the period 0-6 kyr with environmental conditions close to modern ones, the transition time (6-12.5 kyr) and the last glacial (12.5-24 kyr BP) were reconstructed. Diatom spectra records in three cores allowed to study the changes in the oceanic and neritic diatom species during these periods.

Lithological and paleontological proxies clearly showed a strong increase in the ice formation on the northern shelf of the glacial Okhotsk Sea, its extent, major ice melting and IRD discharge in the central part of the sea. The average seasonal duration of ice coverage during glaciation was longer than the modern ones. However, the ice coverage in the Okhotsk Sea did not last the whole year through and melted completely during summer time, except for the far northwestern part which is adjacent to the Amur River estuary. The large increase of sea-ice formation in winter on the northern shelf of the glacial sea led to a significant enhancement of the intermediate water formation in the Okhotsk Sea and the Northern Pacific.

THE MAARS AND THEIR PALEOCLIMATIC RECORDS IN CHINA - A MAAR DRILLING PROGRAM FOR CHINESE-GERMAN COOPERATION

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There are a large number of volcanoes and volcanic fields with maar or maar lakes distributed in the eastern continent margin from the tropic to the temperate zones and the northern Tibetan plateau in China. The oldest one with 125 Ma age can be found in the Cretaceous in Yixian County, the West Liaoning Province. Another old maar with 13 Ma is located in Shanwan, Shandong Province. Most maars and maar lakes occurred in the Quaternary and are distributed in three main regions: Leiqiong volcanic field in south China, Longgang volcanic field, called Chinese Eifel, in northeast China and Kunlun-Kekexili volcanic field on the Tibetan Plateau. The different maars (lake) have different geological backgrounds and different environments so they can record various paleoclimates and paleoenvironments. We have done drilling work with German instruments and got several long cores and short freeze cores from Huguangyan maar lake in the tropic Leizhou Peninsula, south China, and from Shihailongwan and Erlongwan maar lakes in Longgang field in Jingyu, Huinan counties, Jilin Province since 1997. Even no good varves can be found in Huguangyan lake sediment cores, but it was none the less possible to establish a high-resolution time series of the past 40-78 ka by AMS ^{14}C ages and paleomagnetic measurements, especially for Shihailongwan maar lake sediments with excellent varves and tephra layers. After core opening and sampling, the sediment samples were analyzed by multiple methods including datings, chemical, pollen and others, and more data dealing with

paleoclimatic and paleoenvironmental indices were obtained. It was revealed that the East Asian monsoons have rich records in the tropic zone. The paleoclimatic and paleoenvironmental variations in the tropical zone corresponded to solar activity in different time scales and were different from those occurring in high latitude Greenland. In millennium scale, there were strong climatic varied frequencies in the tropical zone during the last deglaciation and Holocene, even interglacial stages within the last glacial period, and no obvious variations in the glacial period from 38ka to 16ka B.P. On the contrary, in high-latitude Greenland, the strong climatic varied frequencies occurred in the last glacial period, and a relative stable climate occurred in the Holocene.There were some periodicals of paleoclimatic variations like 2930a, 1140a, 490a, 250a and 220a in the tropical zone

THE INFLUENCE OF THE FRONTAL ZONE OF THE EAST SAKHALIN CURRENT ON THE DEVELOPMENT OF PHYTOPLANKTON AND THE DISTRIBUTION OF MERCURY AND METHANE CONCENTRATIONS IN SEA WATER

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Increased quantities of methane (up to 6000 nl/l and more) and mercury (up to 1.8 mkg/l) come into the water of the eastern shelf off Sakhalin as a result of the high seismicity of this region. The less saline and cold shelf waters get into contact with more saline and warm deep-sea waters at the frontal zone of the East Sakhalin current in the area of the continental slope. The hydrophysical and hydrochemical characteristics of this front were well expressed, especially at its approach to the shelf edge at a distance of 5-30 km during the meandering of the East Sakhalin current. The temperature and salinity gradients of the front were weakly expressed, when the front moved off from the shelf edge at a distance of 100-120 km.

The phytoplankton community developed most actively in the front zone. Here, the content of chlorophyll "a" reached 4.0-12.0 mg/m^3. The photosynthetic activity of the phytoplankton was 1.3-6.4 times higher in the front than in ambient waters. The front zone coincided with the biological border of the phytoplankton distribution. On the cold side of the front, a more clearly expressed domination of separate species of microalgae (Thalassiosira sp., Chaetoceros socialis and Navicula sp.) and deeper (up to 75-100 m) locations of quantity and phytoplankton biomass maxima were characteristic for the phytoplankton community. The diatom species in the shelf community was more abundant than in open sea waters (93,1 - 99,6 % and 85,0 - 90,4 %, respectively). The phytoplankton biomass of the shelf community (up to 17480 mg/m^3) was 3.5 times more than the biomass in open sea waters.

There were essential changes in the distribution of methane and mercury concentrations in the frontal zone water. A sharp reduction of their concentrations up to background levels and a change of form was observed here. An intensive formation of the particulate form of mercury took place at the internal part of the front zone and of the dissolved form at the external part. This form of mercury was recovered in the water surface layer, in which the phytoplankton community actively developed. But this mercury form did not have any toxical effect on the microalgae.

The methane concentrations decreased most sharply (from 4650 up to 110 nl/l) in the front zone, when it was situated near to the shelf edge. In the frontal zone, local concentration maxima of different chemical agents (carbon dioxide, heavy hydrocarbon gases, oxygen, molecular nitrogen, particulate and dissolved mercury) were discovered in that layer, in which the methane content had its maximum before the front zone. This is caused by the strengthened transformation of these substances at the frontal zone of the East Sakhalin current.

These facts serve as basis to suppose in the frontal zone the existence of active diverse microflora both the freely living form and the form connected with phytoplankton, which absorb and transform methane and mercury into other chemical compounds. These processes, apparently, assist the increase of biological productivity at the frontal zone of the

East Sakhalin current and the intensification of the purification of waters on the East Sakhalin shelf from mercury and methane.

GAS HYDRATES IN THE OKHOTSK SEA - A FIRST QUANTIFICATION OF ASSOCIATED METHANE

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Within the joint German-Russian project KOMEX (**K**urile **O**khotsk Sea **M**arine **Ex**periment) more than 11000 km of reflection seismic data were obtained from 1995 to 2001 in the northwestern Okhotsk Sea and the Kurile Basin. An interpretation of these data shows that the occurrence of free gas or gas hydrates in the sediments is widespread in the entire Okhotsk Sea. This occurrence is documented seismically by gas escape structures, acoustic wipeout or blanking and by a prominent bottom simulation reflector.

Conductive heat flow was computed from the depth distribution of the BSR. The results show that the average heat flow in the northwestern Okhotsk Sea is about 30 mW/m^2. Only adjacent to basement highs and around the shear zone, values higher than 60-80 mW/m^2 occur. These high values are attributed to a higher geothermal gradient in tectonically active areas.

The total amount of methane preserved in the hydrate stability zone (HSZ) and trapped as free gas underneath the BSR is evaluated to be 6×10^{12} m^3 for the northwestern Sea of Okhotsk and 5×10^{13} m^3 for the entire Okhotsk Sea. The latter figure represents about 0.1 % of the global reservoir of methane gas from hydrates.

Our study documents that the semi-enclosed Okhotsk Sea offers favourable conditions for the accumulation of gas in its sediments on account of its subarctic climate and the prevailing hydrologic regime. These conditions include high primary productivity, low bottom water temperatures and high sedimentation rates.

PECULIARITIES OF ORGANIC CARBON DISTRIBUTION IN THE KARA SEA SEDIMENTS COMPARED WITH THE LAPTEV SEA

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Kara Sea late Quaternary sediments recovered during the cruise of R/V "Akademik Boris Petrov" carried out during August – October 2001 were studied to determine the genetic types of organic mater. Large rivers' discharge and low temperature condition in the Kara Sea and in the Laptev Sea provide a similarity of the geochemical processes taking place within the upper part of the sediment stratum; nevertheless some differences can be traced by distinct sources of organic matter.

Samples of two gravity cores were examined to determine the organic carbon content and the C:N ratio. Core BP-01-26 is composed of clays in the upper part and of sandy/silty sediments in the lower part. Core BP-01-55 contains a sandy interval at the top and in the lower part and silty clays form the middle part of the core. Each of the cores shows the presence of unstable hydrated calcium carbonate mineral ikaite at the depths 2.2 and 1.5 m, respectively. Ikaite is a typical authygenic mineral of the polar sediments, it was observed in the sediments of the Laptev Sea (Schubert et al., 1997) and on the Antarctic shelf (Suess et al., 1982).

The following study of organic matter origin will be carried out using organic carbon isotope analyses.

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THE RADIOLARIAN *AMPHIMELISSA SETOSA* – A POTENTIAL INDICATOR FOR A NORTH PACIFIC/NORTH ATLANTIC LINK DURING MARINE ISOTOPIC STAGE 5

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The radiolarian species *Amphimelissa setosa* is an important component of the Pleistocene radiolarian assemblages in the Sea of Okhotsk and the North Pacific within the interval of the marine oxygen-isotope stages (MIS) 11-5 (Kruglikova, 1976, 1977; Matul and Abelmann, unpubl. data). The prominent peaks of *A. setosa* occur during the interglacial optima when the biogenic opal accumulation is high. *A. setosa* disappears in the Subarctic Pacific area at the boundary of MIS 4/5 (Matul et al., 2002a). At present, *A. setosa* is one of the typical radiolarian species in the Nordic Seas as shown by plankton, sediment trap and surface sediment studies (e.g., Swanberg and Eide, 1988; Schröder-Ritzrau, 1994; Bjørklund et al., 1998). Its highest abundances occur in the area of the Island/Greenland Seas, which is characterized by cold Arctic and polar water masses and by the interaction of cold fresh Arctic and warm saline North Atlantic waters that provoke an active vertical mixing in a large range of water depths.

The first occurrence of *A. setosa* in the North Atlantic was reported from the Labrador Sea at the end of MIS 5 (Matul et al., 2002b). During the last glacial maximum, *A. setosa* inhabits the North Atlantic north of the glacial Polar Front (Bjørklund and Swanberg, 1987). It is an abundant species of the radiolarian assemblages within MIS 2-4 of the central Labrador Sea (Matul et al., 2002). The species appears in the Nordic Seas during the last deglaciation and exhibits high abundances both in the Norwegian Sea (Jansen and Bjørklund, 1985) and northern North Atlantic [the Skagerrak Strait – Bjørklund (1985); the Reykjanes Ridge – Matul (1994)] during this time. But there still is not any data on the presence of *A. setosa* in the Nordic Seas before the last deglaciation.

The measurements of the basic proportions and dimensions in *A. setosa* shells exhibit apparent similarities between specimens from the Sea of Okhotsk and the Labrador Sea. These similarities suggest a possible link between the occurrence of the North Pacific population of *A. setosa,* disappearing at the boundary MIS 4/5, and the North Atlantic one, appearing at the end of MIS 5. The disappearance of *A. setosa* in the Subarctic Pacific area might be explained by the development of a steeper halocline, preventing deeper water mixing. It might be suggested that *A. setosa* inhabited the Arctic Ocean during the warm phases of MIS 5. It could migrate through the deepest channels (a sill depth of ~200 m) of the Canadian Arctic Archipelago toward the Baffin Bay and Labrador Sea. After the final transition from the interglacial to the glacial mode at the boundary of MIS 4/5 and the associated extent of cold water to the south, *A. setosa* migrated to the central North Atlantic. During the warming of the last deglaciation, *A. setosa* disappeared from the central North Atlantic and moved with the retreat of cold water to the Nordic Seas.

ON THE COMPOSITION OF GAS HYDRATE-FORMING MUD VOLCANO FLUIDS

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The composition of gas hydrate-forming water and gas was one of the major issues during recent studies of the mud volcano sediments in the Black Sea, Caspian Sea, Mediterranean Sea, Norwegian Sea and the Gulf of Cadiz.

Distinct variations were observed in the chemical compositions of mud volcano waters in comparison to sea water: (1) the chlorinity of mud volcano water is two times less than

of sea water (Norwegian Sea); (2) on the other hand, the chlorinity twice exceeds the chloride concentration in the sea water (Caspian Sea), and (3) mud volcano water chlorinity similar to sea water chlorinity was measured in mud volcano deposits in the Gulf of Cadiz. In addition, almost in all studied regions mud volcano fluid is characterized by low Mg/Cl ratio.

Considerable variations of oxygen and hydrogen isotopic compositions of mud volcano water were observed, too. Some waters are characterized by abnormal reverse trends in the hydrogen-oxygen relationship (Gulf of Cadiz, Mediterranean and Caspian Seas). In other regions, this interrelation corresponds to the usual isotopic fractionation during gas hydrate formation (Norwegian Sea).

The composition of hydrated gases also varies in different study areas. Some gas mixtures are mainly represented by methane, up to 99% (Norwegian and Black Seas); in other cases, the gas mixture released from hydrates contains up to 30-40% of C_2-C_6 (Caspian Sea) and up to 18% (Gulf of Cadiz). The enrichment in methane homologues is most likely a result of the initial gas fractionation during gas hydrate formation.

Variations of mud volcano water and gas composition testify to a different nature of gas hydrate-forming fluids. Some of them, based on water isotopic compositions, correspond to the oil- and gas-bearing basins. In this case, the gas dissolved in the water most likely is thermogenic. These types of mud volcanoes are typical for active continental margins.

Other mud volcano systems are more typical for passive continental margins with thick sedimentary cover, including giant slide areas. The composition of the fluids is characterized by relatively low water chlorinity and prevalence of biogenic gas.

The unusual variations of the gas hydrate-forming fluid composition in mud volcano areas allow to suggest that there are different conditions of gas hydrate formation processes. This could be important for future estimations of the gas hydrate content based on indirect indicators of gas hydrate presence in the sediments.

EL´GYGYTGYN LAKE, NE-RUSSIA: A MILLENNIAL-SCALE RECORD OF CLIMATE EVOLUTION IN THE ARCTIC OVER THE PAST 3.6 MILLION YEARS

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The El´gygytgyn Crater, located about 100 km to the north of the Arctic Circle in northeastern Siberia (67°30´ N, 172°05´ E), was created by a meteorite impact ca. 3.6 Ma ago. Russian geomorphological work indicates that the area, despite its northern position, has remained unglaciated since the time of impact. The sediment fill of the lake that presently exists in the crater, thus, has a very high potential to supply a unique, continuous record of the climatic and environmental history of the Arctic since Pliocene time.

In order to test this hypotheses, we have carried out a pilot expedition to Lake El´gygytgyn in April/May, 1998, that focused on shallow sediment coring. The analytical results from the up to 12.5 m long sediment cores, recovered in 175 m water depth, show that the cores contain a continuous sediment succession deposited during the past ca. 400 ka. Distinct fluctuations in various sediment parameters mirror not only the major glacial-interglacial cycles, but also several stadials and interstadials of millennial-scale duration. Basically, four sediment units of individual composition are distinguished, reflecting peak warm, normal warm, cold and dry, and cold, but more moist climate.

Based on these promising results, we conducted a second expedition to El´gygytgyn Lake in summer 2000, during which, besides others, the geometry and thickness of the sediment fill was studied by airgun seismic and 3.5 kHz echo sounding. Refraction seismics using sonobuoys indicate that the sediment thickness amounts to up to 400 m. Single channel reflection profiles exhibit well stratified sediments to a depth of ca. 180 m. These sediments overlay more massive deposits and in the central lake part indicate the occurrence

of a center cone in larger depths that is typical for meteorite impact craters of this size. Whist the sediments close the lake margin are intercalated with debris flow deposits, parts of the central lake part are widely unaffected by sediment gravity transport processes. Extrapolating the sedimentation rates determined on the available sediment cores, the age of the sediment base would be in the order of 7 Ma. An age corresponding to the time of impact, however, is more likely, because one might expect a distinct decrease in sedimentation rates during the global cooling in upper Pliocene time.

The German contribution to future work on the lake shall be conducted within the scope of a BMBF-Project that is planned to start in Oct., 2002. In summer 2003, we intent to conduct an expedition on which (1) the existing geophysical data set is extended to allow the determination of most promising sites for deep drilling of the entire sediment fill, (2) the history of the permafrost in the lake catchment and its influence on the lake sediment formation is studied, and (3) the spatial and temporal variability in the Late Quaternary sedimentation is investigated in more detail. These studies shall function as a pre-site survey for a deep-drilling campaign that is planned to be conducted in 2005 within the scope of the *International Continental Drilling Program* (ICDP).

STABLE WATER ISOTOPES OF ICE WEDGES AS PALEOCLIMATE INDICATOR FOR THE LAPTEV SEA REGION, NORTHERN SIBERIA

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Continuous permafrost is widespread in the non-glaciated coastal lowlands of the Laptev Sea region in Northern Siberia, and may reach a thickness of several hundred meters. Within the framework of the multidisciplinary research project " Laptev Sea System 2000", four working areas were selected for stable isotope analyses of ice wedges: the south coast of Bol'shoy Lyakhovsky Island (73°10'N, 143°50'E), Bykovsky Peninsula, 50 km SE of the Lena Delta (71°40'N, 129°30'E) and two locations in the central (72°20'N, 126°20'E) and western Lena Delta (72°50'N, 123°10'E). In the eastern Laptev Sea area, atmospheric moisture transported from the Atlantic meets Pacific precipitation. Additionally, this region is characteristic for a special and very ice-rich type (up to 80 Vol %) of permafrost called "Ice Complex". The ice wedges within the Ice Complex may reach heights of up to 40 m and widths of 5 m. The presented results of isotopic analyses of ice wedges of the Ice Complex, as well as of underlying and covering deposits allow: (1) the reconstruction of the paleoclimate history from 60 ka BP until the present, (2) the identification of site-specific properties influencing the stable isotopic composition in ice wedges, and (3) combined with literature data from the Taymyr Peninsula, the identification of moisture source regions for winter precipitation.

The application of hydrogen and oxygen isotopes for paleoclimate studies in ice bodies is considered to be one of the best methods for paleotemperature reconstruction. The combination of H and O isotopes has seldom been applied to ice wedges as it is a considerable extension of the method. Ice wedges are principally formed by repeated frost cracking, trickling of snow meltwater into frost cracks, which freezes immediately because of the negative temperatures of permafrost, leading to the formation of an ice vein. Consequently, ice wedges may reflect mean annual winter temperatures. The temporal variation of the stable isotopic composition of ice wedges corresponds to the relative variations of winter temperatures. Additionally, the *d* excess as an indicator for non-equilibrium fractionation processes may provide information on the moisture source regions for winter precipitation, but also on the processes leading to ice wedge growth.

The results of our studies in the Laptev Sea Region indicate pronounced changes in the regional climatic history. The stable isotope data show very cold temperatures around 200 ka and 55 ka BP, still cold and constant winter conditions between 50 and 22 ka BP and a sharp temperature rise for the Pleistocene-Holocene boundary. The three western regions are presently fed by a North Atlantic moisture source region. For Bol'shoy Lyakhovsky Island, another source region (presumably the Pacific) could be distinguished. In the western regions, a displacement of this marine source of the winter precipitation to the north occurred between 18.5 ka and 11.2 ka BP, being possibly linked with the decay of the LGM ice sheet. Nevertheless, for the paleoclimate interpretation of ice wedges, it has to be

ascertained that no secondary effects i. e. exchange processes at the boundary ice wedge/ice-rich sediment, changed the stable isotope signal.

HOLOCENE PALAEOSEISMIC AND CLIMATIC RECORD IN LAMINATED SEDIMENTS FROM THE DEAD SEA, ISRAEL

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The Dead Sea, situated at the transition between the Arabian Desert and the Mediterranean climatic zones, is a potential location to study climatic fluctuations in the Near East. During a drilling campaign in 1997, a total of eight sediment cores were recovered from different sites on the western shore of the Dead Sea. The profiles consist of different lacustrine to fluvial sediments reflecting lake level fluctuations in the Dead Sea. The lacustrine sequences are composed of alternating fine layers of clastic marls and aragonite. Radiocarbon dating on plant relics indicated that the sediments were deposited during the last 10,000 years. The results of detailed microscopic investigations on the upper part of this profile could verify that the laminae reflect annual deposition.

The highly accurate chronological framework obtained for the laminated sequences (from laminae counting and radiocarbon dating) enabled a detailed, continuous compilation of seismic events during the Holocene for the first time. The comparison of the deformed sequences of the profile with the historical record of strong earthquakes of the Dead Sea region are in good agreement for the past 4,650 years. Using multiple marker horizons, a correlation of the different sites could be established.

The combined results of lithological studies, initial stable isotope measurements, and the chronology of each site indicate different phases of sedimentation during the Holocene following a period of halite precipitation 10,000 yrs B.P. Two periods of changing in the rainfall distribution pattern in the Dead Sea region could be observed, between 8,000 and 6,500 yrs B.P., and between 4,200 and 3,500 yrs B.P. The sedimentation rate of the Dead Sea basin was higher during the first of the two periods, probably caused by a higher erosional transport during more arid conditions and a reduced vegetation cover. A sudden increase in aridity from 3,500 yrs B.P. to recent times is documented by the presence of gypsum layers and secondary halite crystals at the top of the profile.

A 78,000 YEAR RECORD OF CLIMATIC CHANGES FROM THE SOUTH CHINA COAST - HUGUANG MAAR LAKE (HUGUANGYAN)

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The Huguangyan is a small, 20 m deep maar lake located within an inactive volcanic field on the northern coast of the South China Sea. The longest section from several overlapping drill sites containing more than 45 m of lake sediments, provided a ca. 78,000-year complete record of local palaeoclimatic and palaeoenvironmental changes. This region experienced variable influences from the SE-Asian summer monsoon, the winter monsoon and changing sea levels. Our interpretations are based on high-resolution dry density and magnetic susceptibility data, pollen investigations, estimations of total organic and inorganic carbon, total nitrogen, biogenic silica and ^{14}C age determinations mainly derived from single leaves.

During the Last Glacial Stage sudden shifts of the palaeoenvironmental conditions at the Huguangyan site correspond well with the timing of palaeo-climate change known from marine and ice core records. However, the Huguangyan record sometimes shows an anticyclic behavior with a relatively warm and humid MIS 4 and a climatic deterioration at the beginning of the MIS 3. In contrast to the millennial-scale fluctuation between stadials and interstadials known from Greenland ice core records, the chronological equivalent of

MIS 3 at the Huguangyan site is characterized by a warm and humid interval between 48,000 and 40,000 years BP and a long-lasting, stable cool and dry period between 40,000 years BP and the onset of Termination I. However, at Termination I the Huguang maar record shows striking similarities with high resolution records from the South China Sea and the Greenland ice cores. During the Holocene there are more pronounced amplitude changes, especially in the high-resolution physical data set than during the full glacial stage. The early Holocene monsoon maximum is followed by a dryer period between 7,000 and 5,000 years cal BP. Such a pattern has also been reported from marine records of the South China Sea (Wang et al., 1999). The onset of a perceptible human influence could be inferred at about 4,000 years ago from the increasing sedimentation rates and changes in the pollen spectrum.

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MODERN AND PAST RECORDS OF SHELF HYDROGRAPHY IN THE LAPTEV SEA

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It is now widely accepted that changes in surface ocean hydrology at northern high latitudes are a major forcing mechanism that can strongly perturbate a particular climate mode. Given the variability on subdecadal and on centennial to millennial timescales, the dispersal and fate of riverine water discharge and its role in the ice regime as well as in surface water properties is a central issue in the understanding of Holocene climate change in the arctic marginal seas, the Arctic Ocean, and beyond. To get a better understanding of the climate system of the north polar region, it seems crucial to investigate processes that are based on sufficiently long time series. Records that go back in time hundreds or thousands of years can be provided only through paleoclimatic studies.

Stable oxygen and carbon isotope profiles from living and fossil aragonitic bivalves were investigated in order to trace modern and past hydrographic changes in the strongly coupled land-shelf system of the Laptev Sea. Detailed stable isotope measurements were executed on the shells along their axis of maximum growth. These profiles provide an isotopic record of hydrological and environmental changes for the lifespan of the individual bivalves. The oxygen isotopic records exhibit amplitude cycles interpreted as recording annual cycles. Based on the well-known relationship between the carbonate $\delta^{18}O$, temperature and the isotopic composition of water, it is possible to relate phases of more negative (lighter) $\delta^{18}O$ values indicating summer and more positive (heavier) $\delta^{18}O$ values indicating the winter season. The main forcing factor of the $\delta^{18}O$ variations is the variability of the isotopic composition of the bottom water. Measurements of $\delta^{18}O$ in surface and bottom waters of the Laptev Sea show a linear relation of salinity and water $\delta^{18}O$ with a coefficient of 0.50 ‰/salinity. The $\delta^{18}O$ and $\delta^{13}C$ cycles from growing profiles of the living bivalves indicate a correspondence to seasonal hydrographic changes and can be compared with synoptical data.

Given the seasonal cycles in living bivalves, stable isotope profiles of fossil, radiocarbon-dated, and well-preserved bivalve shells from sediment cores are used to reconstruct the Holocene variability of riverine runoff and its influence on the hydrology during snap-shot views of the postglacial transgressional history of the eastern Laptev Sea shelf. If we assume that the relationship between $\delta^{18}O_w$ and salinity was relatively constant, our results would suggest that around 8.4 ka BP the investigated site was more influenced by riverine water. Regarding the inundation history of the Laptev Sea the sea level was lowered by ~ 25 m during that time. The reconstruction indicates that the particular study site was much more affected by warm, less saline riverine water caused by the proximity to the coastline and to the paleo-river mouth. After this time the postglacial transgression

induced a further southward retreat of the coastline and the study site became dominantly influenced by saline seawater.

TEMPERATURE AS A REGULATION FORCE FOR GAS EVOLUTION

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A precise description of sources and sinks of CO_2 is significant for understanding carbon cycling in tundra ecosystems. CO_2-evolution of soils originates mainly from biological processes, which means that environmental parameters are decisive factors determining this process. Metabolism restrictions are of biological (e.g. nutrient status) and physical (e.g. temperature) origin. Regarding the wide growth range of microbes, the environments of polar landscapes offer only a small range of soil temperatures which allow active metabolic processes. Water, above all accessible water, is essential for metabolism of microorganisms. Freezing and drying withdraw the soil water temporarily or on a long-term scale. Soil freezing, as a temporary removal of water, is a substrat specific process and occurs roughly at a temperature range between 0°C and -5°C. Not only does the amount of liquid water determine metabolic processes, but also the solutes in the pore water. Dissolved ions, particularly Na^+, Cl^- and small organic molecules derived from cell solutes, vie for water as a solvent and desiccate the soil system. CO_2-evolution of permafrost soils is limited to the active layer, that part of the soil where thermic conditions enable the occurrence of liquid water. The amount of liquid water must be sufficient to allow diffusion of molecules and/or transport of particles. Temperature and water availability are so closely connected that they should be regarded together.

Recent studies have investigated winter CO_2-fluxes in northern and other severely cold ecosystems. Respiration as CO_2-source is mostly negligible because of soil temperatures far below -5°C. Possible exceptions are: a) release of CO_2 from freezing soil during ice formation, and b) release of subsurface CO_2 because of mechanical disturbances (differential expansion and contraction of soil during freezing).

To evaluate the relationship between boundary conditions of soil respiration and winter CO_2-emission we determine the limiting physical properties of microbial processes. Attention is focused on the osmotic pressure. Osmotic diffusion controls the semipermeable transport through the cell membran and the limits of the cells for water up-take.

HOLOCENE POLLEN RECORDS FROM THE LAPTEV SEA

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During the postglacial sea-level rise the investigated landscape gradually changed from a terrestrial-fluvial to a marine environment. At present this region is bounded to the north by the vast and shallow shelf which constitutes a prime area to study land-ocean interactions. Various biological, micropaleontological, palynological, and sedimentological data obtained from the Laptev Sea seafloor reflect that the largest part of the sediments has been brought to the sea with winds, rivers and with drifting ice. The data provide a detailed history of the depositional regime and contain information on the general paleoenvironmental changes of the Laptev Sea and the adjacent land during the Holocene. As our studies have shown, in suitable sedimentary setting pollen records from near-coastal marine sediments can give reliable information on climate-related vegetational changes on land.

Within the scope of the"Laptev Sea System" project, detailed palynological investigations were carried out on several sediment cores from the Laptev Sea shelf. One of these cores (PM9499) is from the submerged Anabar-Khatanga valley and others (PM9462, IK9373, PS51-135) are from the eastern part of the Laptev Sea to the southwest of Belkovsky Island in the submerged Yana valley. Using the radiocarbon-dated sediment core from the eastern Laptev Sea the first detailed account on the sea-land linkage on the basis of

palynological analysis was obtained. The chronology of the core reaches back to 9.4 cal. ka. This means that the pollen record starts at the time when the forest commenced to expand beyond its modern northern limit, reaching a maximum extension between 9 and 3.8 cal. ka. A similar trend is also seen in the sum of arboreal pollen, which is dominated by conifers. However, arboreal pollen in this core started to increase in abundance after 7.5 cal. ka, about 1.5 cal. ka later than on land. The high sedimentation rate and increase in river activity that persisted from 7.6 to 4.0 cal. ka may be correlated with the period for which pollen and organic runoff data indicate warmest conditions, with a fully developed forest just south of the Lena Delta. A similar time-coeval accordance between land and shelf pollen records is observed for the late Holocene climatic cooling trend in Arctic Siberia. In the sea record, this cooling is characterized by increasing abundance of herbaceous pollen that commenced shortly after 3 cal. ka with a slight time lag. However, major trends in climatically crucial spectra, such as arboreal and herbaceous pollen, are in good chronological accordance with Holocene pollen records on land.

NUTRIENT FLUX IN THE EAST SIBERIAN SEA

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The East Siberian Sea is difficult to access and is characterized by severe climatic conditions. Hence, up to the present the East Siberian Sea is one of the less intensively studied arctic regions. Nevertheless, this is a unique region and contains a huge amount of mineral resources according to preliminary data.

Besides, the East Siberian Sea has a number of peculiarities – it is the shallowest, most ice-covered sea and there are the mostsunny days per year at this region. Owing to the perspective of the Russian shelf development in the Arctic seas and possible pressure on the sensitive arctic nature it is necessary to understand the environmental processes in the Arctic seas, especially the exchange and transformation matter, and the nutrient fluxes in particular.

The two-layer model has been built according to recommendations of LOICZ (Land Ocean Interactions in the Coastal Zone) for the estimation of fluxes and of the amount of nutrients.

In the course of one year nitrogen and phosphorus is being consumed in the surface layer. Transferred mineral forms of nutrients are insufficient to replenish losses in the system. Assuming a stationary state of the system replenishment may take place at the expense of biochemical decomposition of organic matter by heterotrophic organisms.

According to stoichiometric calculations (p - r), for which Redfield's ratio is used (C:N:P=106:16:1), on the whole the East Siberian Sea may be determined as a heterotrophic system during the whole year, but the surface layer is an autotrophic system.

The waters of the Laptev Sea have a great influence on the western part of the East-Siberian Sea. The following results have been obtained: through Dm. Laptev Strait during the summer period about 26,300 tons of phosphates are carried out into the East Siberian Sea and through Sannikov Strait – about 36,600 tons.

ADVANCES IN CORRELATION OF EUROPEAN HIGH-RESOLUTION PALAEOCLIMATIC RECORDS

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Understanding regional aspects of past climatic changes requires precise dating and correlation of high-resolution palaeoclimatic archives. Therefore, it has been one of the main goals of the European Lake Drilling Programme (ELDP) to further such correlation of European sediment records. ELDP is a networking project that during the past five years (1996-2000) has stimulated links amongst scientists working with high-resolution archives of environmental change in Europe. A major outcome of this joint effort is a considerable progress in terms of both development of methods and the establishment of a network of

regional links between high-resolution records. This includes not only terrestrial but also marine-terrestrial links. Here we present two examples from (1) the Mediterranean region and (2) Central Europe.

(1) The high-resolution sediment record of the last 100,000 years from Lago Grande di Monticchio in southern Italy is dated by varve counting and precise sedimentation rate calculation based on measured varve thickness. It is shown that palaeomagnetic inclination variations from this record can be used for correlation with lake records from Greece and Israel. Furthermore, the deposition of >340 tephra layers in the Monticchio sediments enable a detailed network of links to many marine cores from the Mediterranean Sea as well as many lake records even as far north as the southern Alps.

(2) Varved late glacial sediment records along a west-east transect from Western Germany to Poland (Meerfelder Maar – Hämelsee – Lake Gosciaz) are correlated based on independent varve timescales. As a result, it has been proven even for the very short biozones of the Late Glacial (100 – 1,100 years) that they have been of about the same duration along this transect. An extension of this correlation network to varved records in the peri-alpine area in southern Germany and Switzerland shows that despite terminological differences of biozones between the northern and southern part the sedimentological and palynological signals are well correlated. Further teleconnections to the GRIP Greenland ice core (again based on independent increment chronologies) proves that late glacial climate oscillations in the whole area have been synchronous within the error margin of the timescales.

KIHZ I. KIHZ - NATURAL CLIMATE VARIATIONS: OVERVIEW AND CLIMATE ARCHIVES

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The project "Natural climate variations from 10,000 years to the present day" (Klima in historischen Zeiten, KIHZ) is a joint effort to analyze the dynamics of natural climate variability. KIHZ was formed in 1998 by geoscientists and climate modelers from five German National Research Centers, members of the Helmholtz Association with the goal to create a synergy between proxy data and numerical modeling of the ocean-atmosphere-system. In 2000, 9 groups from universities and institutes of the Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL) joined KIHZ. Data from continental and marine climate archives such as ice cores, tree rings, corals, lake and marine sediments from different locations across both hemispheres are systematically combined with dynamic realistic climate modeling and data assimilation. The different archives, to be organized along a consistent synthetic time scale, will be integrated to form a multi-proxy-parameter network. Data administration and exchange is achieved through the information system PANGAEA. The project thus comprises three main segments, (i) analysis of geological archives, (ii) evaluation of existing paleoclimate data and time series, and (iii) climate modeling. Project progress is achieved through annual workshops where all project members present their work in progress, and frequent, smaller ad-hoc meetings that focus on specific questions being raised by project participants. Preliminary results show that many archives reveal larger amplitudes than what would be expected to result from reconstructed temperature changes. Thus, a major portion of climate variability during the Holocene must be attributed to changes in the hydrological cycle. Also, all archive data show a strong response to regional climate forcing and local effects. Through the combination of proxy data and climate modeling, KIHZ will test which regions, variables and time scales can be realistically simulated by GCM's, and whether the trajectory of climate simulations can be driven by the assimilation of proxy data.

LGM GLACIATION AND SIBERIAN RIVER RUNOFF IN THE KARA SEA: RESULTS FROM THE RV "BORIS PETROV" EXPEDITION 2001 (SIRRO-PROJECT)

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In the area of the Kara Sea uncertainties remain about the location of the eastern boundary of the Eurasian ice sheet during the Last Glacial Maximum (LGM) or Marine Isotope Stage 2 (MIS-2). The key question is whether or not the LGM ice sheet extended across the central-northern Kara Sea onto the area west of the Severnaya Zemlya Archipelago up to the most northerly terrain of the Taymyr Peninsula. Between 1999 and 2001, and within the framework of Russian-German cooperation (Project SIRRO, Siberian River Runoff), several cruises to the Kara Sea were carried out by the Russian research vessel "Akademik Boris Petrov" in order to investigate the recent and past imprint of the large Siberian Rivers Ob and Yenisei on the Kara Shelf Sea and the Arctic Ocean. Knowledge about the extent of the LGM ice sheet on the Kara Shelf is fundamental for understanding the history of Siberian river input. In case of a continuous LGM glaciation between the Barents Sea and the Taymyr Peninsula fluvial discharge into the Arctic Ocean was possibly dammed for several thousands of years whereas otherwise river runoff continued across the exposed Kara Shelf.

A preliminary interpretation of high-resolution seismic images (1-12 kHz) and sediment cores obtained during the last RV "Boris Petrov" cruise (2001) combined with older data indicates a facies boundary interpreted as related to the eastern boundary of an LGM ice sheet. In the western area under investigation, this boundary forms a distinct line of change in relief which can be mapped from approximately 75°30'N, 73°E up to 78°80'N, 80°E. Further to the east, subbottom morphology suggests glacial overprint but an age of formation during LGM is uncertain because, in places, the glacial surface is overlain by thick packages of mud including 2 to 3 acoustic units. Unit geometry implies sedimentary environments of changing water depths related to eustasy, isostatic rebound or both. Preliminary results of radiocarbon dating do not exclude the extent of an ice sheet from 78°80N, 80E to 77°50'N, 102°39'E during LGM times. The latter location is near the western end of the Vilkitsky Strait where a submarine terminal moraine is documented in seismic images. This would imply a continuous ice-sheet cover in the northern Kara Sea during MIS-2. In all other locations investigated further to the east (Vilkitsky Strait, Laptev Sea), as well as in lakes on the Taymyr Peninsula, evidence is found suggesting that the last glaciation occurred considerably earlier than during MIS-2. However, in the central and southern Kara Sea no hints are found for ice-sheet damming of the Siberian Rivers Ob and Yenisei during LGM times. Incised channels are documented in ice-free shelf areas indicating that drainage toward the Arctic Ocean continued during times of lower sea levels. Paleovalleys are filled with sediments of Holocene age which suggests southward migration of depot centres. After about 7 ka BP the present Ob and Yenisei estuaries act as major sediment sinks of terrigenous material. Accumulation of sediments in the estuaries is highest within the zones of salinity gradients from sea water to fresh water. A high-resolution seismic key profile across the outer Yenisei estuary exhibits a fluvial dominated depositional environment for the early Holocene associated with channel and overbank deposits. The unit of early Holocene fluvial sediments gradually evolved into more marine influenced deposits forming a typical drape toward the top of the sequence. The whole succession represents a typical deepening upward sequence interpreted as part of a transgressive system tract.

SEDIMENT SUPPLY AND DISTRIBUTION IN THE SEA OF OKHOTSK DURING LATE QUATERNARY (BASED ON THE ANALYSIS OF HEAVY MINERAL ASSOCIATIONS)

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About 500 mineralogical analyses of heavy minerals from both surface sediments and sediment cores have been carried out along three latitudinal profiles intersecting the Sea of Okhotsk in the southern, central and northern part respectively. The different sediment cores were correlated by using results from tephrachronology, lithostratigraphy, magnetic susceptibility and biostratigraphy.

Several tephrastratigraphic markers (e.g. volcanic ash layers K_0, K_2, TR, K_3, K_4) were distinguished and identified in the cores. The heavy mineral associations of studied cores have been compared with mineral associations of possible source areas of the surrounding land.

This correlation was done by using multivariant statistical methods (Q- and R-mode factor and discriminant analyses) and mineralogical coefficients (sialic and volcanogenous).

From these investigations, conclusions can be drawn about variations in delivery conditions and distribution of sedimentary material and, in particular, about the increase of the Amur River discharge and the intensification of volcanic activity in different periods of the Late Quaternary.

BALANCE MODEL OF HYDROCHEMICAL REGIME OF THE LAPTEV SEA

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The study of nutrient distribution is of the utmost ecological importance, because nutrients are the mineral base for primary production in the sea. The nutrient distribution in the Laptev Sea has been studied since 1932. A unique hydrochemical database has been prepared at the AARI containing data collected during arctic expeditions for the whole period of observations. However, nearly all these data fall to August-September and April-May in spite of a long series of observations, and the surveys have not always covered the entire water area of the sea. Therefore, a demand arose for the usage of modeling for studying the nutrient distribution and its seasonal variability.

The aim of the present work is to simulate the nutrient distribution and its seasonal variability in the Laptev Sea using a balance model of the hydrochemical regime.

The balance model of the hydrochemical regime of the sea has been elaborated within the framework of this project. Recommendations for modeling in the shelf zones of the World Ocean proposed by LOICZ in 1996 (Gordon et al., 1996) were used for the development of the main calculation blocks of nutrient fluxes.

The seasonal cycle of silicate, phosphate, nitrate, and nitrite distributions in the Laptev Sea was simulated for the year 1993 using the balance model of the hydrochemical regime. A comparison of calculation results with actual observation data revealed that concentrations of dissolved silicate, phosphate, nitrate, and nitrite are in a good correspondence.

DETAILED RECONSTRUCTIONS OF DEPOSITIONAL ENVIRONMENTS AND WATER SALINITY FLUCTUATIONS ON THE EASTERN LAPTEV SEA SHELF DURING THE EARLY TO MIDDLE HOLOCENE

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As a result of postglacial sea level rise the shallow (< 100 m water depth) Laptev Sea shelf was rapidly flooded during the first half of the Holocene. A swift southward retreat of the coastline caused a dramatic change in overall depositional environment in the Laptev Sea (Bauch et al., 1999). During the Early-Middle Holocene (since 10 ky - until 5 ky) the sea level raised from approximately - 45 m to the modern position of the coastline with different rates of sea level rise (Bauch et al., 2001). Whereas the depositional environments (e.g. rates of sedimentation, input of terrestrial organic matter) have been studied from different regions of the Laptev Sea (Bauch et al., 2001; Mueller-Lupp et al., 2000), little is still known about the development of hydrographical parameters, such as water salinity, sea-ice conditions, distribution of water masses within the Laptev Sea shelf during this main phase of the southward retreat of the coastline.

Core PS-51/135-4 used in this study was obtained from the submarine channel of the Yana River at a water depth of 51 m. The core is nearly 5 m long, and covers the time interval 11.1 – 5.3 ka BP according to detailed AMS^{14} dates. For the purpose of reconstructing variations in riverine discharge and surface water salinity we used the ratio between marine and freshwater diatoms, and the ratio between dinoflagellate cysts represented by marine species and cysts of freshwater chlorophyte algae, which are transported to the sea shelves by rivers. The established linkage between distribution patterns in relative abundances of these groups of microfossils in surface sediments of the Eurasian Arctic seas and the surface water salinity indicates that they can be utilized to make assumption on paleosalinity fluctuations in the Laptev Sea (Bauch et al., 2000; Bauch and Polyakova, 2000; Kunz-Pirrung, 1998).

On the basis of the data, the following paleoenvironmental events are recognized for the early-middle Holocene history of the Eastern Laptev Sea shelf. The time span of 11.1-10.7 ka BP was characterized by ”avalanche-like precipitation” of freshwater diatoms in the inner shelf zone near the former location of the river mouth. Chlorophyte cysts are predominated (up to 80%) among aquatic palynomorphs with a high chlorophyte/dinoflagellate cysts ratio of -3.9. The following time interval (10.7-9.6 ka BP), characterized by an overall decrease of concentrations and relative abundances of freshwater diatoms and chlorophyte cysts (down to 2%, mean chlorophyte/dinoflagellate cysts ratio -0.4), indicates a transitional phase. During the time interval from 9.6 till 9.0 ka BP, the relative abundances of dinoflagellate increased up to 96%, and is characterized by a dominance of *Algideashphaeridium minutum*, *Brigantedinium spp*. and *Operculadinium centrocarpum*; the latter species is an indicator for the presence of Atlantic water masses on Arctic Siberian shelves (Kunz-Pirrung, 1998; Matthiessen et al., 2000). The time span of 9.6-5.3 is characterized by a gradual increase of relative abundances of marine diatoms and dinoflagellate cysts indicating the development of full marine conditions.

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SEDIMENTARY MATERIAL TRANSPORT BY SEA ICE IN THE LAPTEV SEA AND ADJACENT ARCTIC OCEAN

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The studying of sedimentary material in sea ice adds to the knowledge about modern sedimentation in Polar areas. The aim of this work is the study of the mineralogical and chemical composition and grain size distribution of ice-rafted sedimentary material.

The samples were collected during two expeditions. The first expedition was the XIV/1a cruise of RV “Polarstern” (1998). We collected the samples of dirty ice in the central part of the Arctic Ocean. The second expedition was in 2000 to the area of the Mendeleev Ridge. The samples of snow and ice were collected aboard research vessel “Akademik Fedorov”.

Mineral composition and grain size distribution were studied in smear slides by microscopy. The chemical composition of samples was studied by instrumental neutron activation analysis and photocolorimetric methods in the laboratories of the P.P. Shirshov Institute of Oceanology and the V.I. Vernadsky Institute of Geochemistry of the RAS.

Our studies demonstrate that:

Silt was abundant in the sedimentary material of the central part of the Arctic Ocean. Silt consists mostly of quartz and feldspars.

Terrigenic material dominated in the sedimentary material of dirty ice.

The pelitic fraction is abundant in the sedimentary material of the Mendeleev Ridge area.

At the top and bottom of the ice cores a little content of silt was registered. At the top of the cores terrigenous material is of aeolian origin. At the bottom of the cores silt is of biogenic origin. Biogenic matter came there from seawater when ice was forming.

The high enrichment factors of As, Se and Sb connected with atmospheric input.

Our chemical data have a good correlation with the literature data for the Laptev Sea. So the area of the Laptev Sea is one of the most active and important areas for the entering and transport of sedimentary material to the central part of the Arctic Ocean.

Our work was financially supported by the German and Russian Ministries for Science and Technology within the framework of the Otto Schmidt Laboratory fellowship and “Laptev Sea 2000” project.

PALEOCEANOGRAPHIC STUDIES IN THE SEA OF OKHOTSK - IMPLICATIONS FOR THE GLACIATION HISTORY OF NE-SIBERIA

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The extent of the Late Weichselian glaciation in the Russian Arctic is discussed controversely until today. The most extreme "Grosswald"-model of extended long-lived ice sheets and domes covering large areas of N- and NE-Siberia including the Sea of Okhotsk (Grosswald & Hughes, 1998), however, contradicts to our marine-geological studies in the Sea of Okhotsk.

Since 1996, we have recovered many sediment records from large areas of the Sea of Okhotsk. The undisturbed sedimentary records can be correlated basin-wide, and the longest records cover approximately 350.000 years of paleoceanographic and paleoclimatic evolution. Detailed studies on stable oxygen isotopes of planktonic foraminifers and on ice-

rafted detritus (IRD, defined as >63µm) helped us to further constrain the glaciation history of NE-Siberia.

Most strikingly, IRD is continuously present in all our sediment records over the entire time period with strongly enhanced IRD accumulation rates during glacial periods. Icebergs serving as transport agents for the large amount of IRD can be ruled out for both the modern situation as well as for the last glacial (stable oxygen stages 1-4) mainly due to the fact that large glacier systems ashore were not present. Seasonally varying and highly mobile sea ice is therefore suggested to serve as the dominant transport mechanism to distribute IRD basin-wide. Coastal adfreezing is presumably the most important entrainment mechanism for IRD into the sea ice of the Sea of Okhotsk.

Consistent with the modern sea-ice pattern in the Sea of Okhotsk, the highest accumulation rates of IRD appear in the northern and western parts of this NW-Pacific marginal basin. Here, sea-ice formation is driven by cool NW-winds, fresh water contribution and polynya processes. The eastern part, instead, is characterized by low IRD accumulation rates. The intrusion of the relatively warm and shallow Kamtchatka Current prevents sea ice formation off Kamtchatka even during winter times.

This modern pattern of sea-ice distribution is apparently relatively stable during the stable oxygen isotope stages 1-5 as indicated by various time slice reconstructions of IRD showing marked west-east gradients in IRD distribution. During glacial stage 6, instead, the main depositional center of IRD shifted from the northwestern Sea of Okhotsk to the eastern part off Kamchatka. Accumulation rates of IRD contemporaneously increased and became larger by a factor of 2 to 3 compared to the glacial stage 2-4 IRD accumulation rates. The change in the depositional center of IRD suggests that IRD transport mechanisms changed considerably. We speculate that during large periods of glacial stage 6, calving icebergs from the strongly glaciated Kamtchatka Peninsula provided large amounts of IRD to the eastern part of the Sea of Okhotsk. Anomalously light stable oxygen isotopes of planktonic foraminifera during stage 6.3 and during Termination II undoubtedly point to significant melt water discharge from Kamtchatka, supporting the assumption of pronounced glaciation of Kamtchatka Peninsula.

LONG-TERM ENVIRONMENTAL EVOLUTION IN THE SEA OF OKHOTSK - EVIDENCE FROM A LONG IMAGES CORE

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In the framework of the international IMAGES VII circum-Pacific initiative in 2001 (WEPAMA), two long sediment records (each ca. 46 m long) from the central part of the Sea of Okhotsk (NW-Pacific marginal basin) were recovered by the french RV MARION DUFRESNE in order to examine the Pleistocene evolution of intermediate water formation, surface water productivity and sea-ice coverage. The Sea of Okhotsk remains even today a poorly investigated area from the paleoceanographic point of view. The selection of sites was clearly defined by maritime boundary regulations, but nevertheless based on previous studies in this area. During the last few years, the joint German-Russian project KOMEX gathered a suite of long gravity cores (max. 11 m length), which cover the last 350.000 years of paleoceanographic evolution in the Sea of Okhotsk. These cores are stratigraphically classified (litho-, bio-, magneto-, isotope-stratigraphy, tephrachronology). The exact positioning of the IMAGES cores was conducted under consideration of extensive sediment-echosounding surveys.

The IMAGES campaign contributed new aspects mainly due to the fact that the CALYPSO GIANT PISTON CORER allowed to penetrate much deeper into the sediments. Based on a still preliminary age model, the sediments recovered cover a time period of ca. 900.000 years. This is the longest paleoceanographic record ever gained in the Sea of Okhotsk. Our research activities currently concentrate on the following topics and questions: How did marine productivity develop since the beginning of Pleistocene? Are extreme productivity events exclusively restricted to the last 600 kyrs, when the global climate was dominated by 100 kyr-orbital cycles? Or do they reach back into times, when Earth´s climate was dominated by 41 kyr-cycles?

Until now, high resolution records of magnetic susceptibility, color, calcium carbonate, and total organic carbon are available. As could be shown by our previous investigations, the magnetic susceptibility mainly reflects terrigenous supply via sea ice, while color-b-

values nicely match opal concentrations. Both proxy data series support the paleo-environmental reconstructions already derived from the study of core LV28-42 (central basin). The depositional environment is dominated by terrigenous-siliciclastic material. Ice-rafted detritus is present in varying abundances through the long sedimentary records. The monotonous sequences, however, are interrupted by short events of extremely high productivity, which characterize the end of glacial terminations and the subsequent interglacials. During glacials, surface productivity is significantly reduced. For the last approximately 5-600 kyrs, the productivity events exhibit an orbital cyclicity of ca. 100 kyrs (eccentricity) and last typically for about 20 kyrs. Before, the 100 kyr-orbital cyclicity changes into a shorter-term cyclicity of presumably 41 kyr (obliquity). Productivity maxima during warm periods relate to an increase in fluvial nutrient supply via the Amur River, reduced sea -ice coverage, and enhanced water mass stratification (formation of the dichothermal layer).

ORBITAL TO SUBORBITAL PALEOCEANOGRAPHIC AND PALEOCLIMATIC CHANGES IN THE SEA OF OKHOTSK

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Marine-geological investigations in the Sea of Okhotsk reveal the great paleoceanographic potential of this NW-Pacific marginal basin. The carbonate-containing sediments allow to establish a continuous high-resolution oxygen isotope stratigraphy for the last approximately 350.000 years, which is outstanding in the Subarctic-Pacific area. The recent recovery of a 46 m piston core within the IMAGES program extended the paleoceanographic record back to about 900.000 years.

The deposits facilitate insights into the closely-coupled interplay between terrigenous supply, sea ice coverage and surface productivity. The depositional environment is dominated by terrigenous-siliciclastic material. Ice-rafted detritus is present basin-wide in varying abundances through all sedimentary records. The monotonous sequences, however, are interrupted by short events of extremely high productivity, which characterize the end of glacial terminations I, II, III, IIIa, IV and the subsequent interglacials (MIS 1.1, 5.5, 7.3, 7.5, 9.3). During glacials, the surface productivity is reduced by a factor of 5 to 10. The productivity events exhibit a cyclicity of ca. 100 kyrs and last typically about 20 kyrs. Productivity maxima are related to an increase in fluvial nutrient supply, reduced sea ice coverage and enhanced water mass stratification (formation of the dichothermal layer).

Apart from orbital-scale paleoceanographic and paleoclimatic changes, we also observe shorter-term environmental changes during glacial stages 2, 3 and 4 on millennial time scales. Distinct variations in terrigenous supply (indicated by titanium and potassium concentration, magnetic susceptibility and the portion of siliciclastics) and marine productivity (biogenic silica) apparently reflect stadial/interstadial changes similar to the Dansgaard/Oeschger cycles of about 1500 years observed in the GreenlandGISP II ice core. During interstadials, high opal concentrations point to an enhanced marine productivity during warm periods, while during stadials, the high titanium concentrations reflect an increase in terrigenous supply, most presumably via sea-ice transport.

Unrivaled for the NW-Pacific area, we additionally established a high-resolution record for the Holocene climatic evolution. The core recovered from the continental slope of Sakhalin exhibits sedimentation rates of ca. 12 cm/100 years and thus provides insight into environmental changes on multidecadal time scales. During the last 9.000 years, variations in sediment composition correlate surprisingly well to the climatic variations oberved in Greenland (GISP II ice core), pointing to the high northern latitudes for initiating climate change. Our studies allow us to reconstruct Holocene variations in marine productivity, Amur river outflow, intermediate water formation and the NE-Asian climate in ultra-high temporal resolution.

METHANE DISTRIBUTION IN THE WATER COLUMN OF THE OKHOTSK AND JAPAN SEAS

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Investigations of the methane distribution in the water column have been carried out in the Sea of Okhotsk by the KOMEX project (1998-2000) and in the Sea of Japan by the PICES project (2000-2001). The comparison of methane distributions in the water column of the Okhotsk and Japan Seas yielded the following results:

1. The main sources of methane along the Sakhalin shelf and slope (Sea of Okhotsk) are oil and gas deposits and dissociating gas hydrates. Oil-gas-bearing deposits with a thickness of about 8-10 km are well known from this area. The area is tectonically active, and several fault systems occur in the sediments and basement rocks. It has a high seismic activity indicated by many earthquakes, one of them in Neftegorsk in 1995 with a magnitude of more than 7. Mud volcanoes occur frequently on the Sakhalin shelf and also on the coast. The number of gas fluxes (for example methane) from fault zones into the sea and of mud volcanoes at the coast increases in periods of seismo-tectonic activity. Methane arises from oil-gas-bearing sediments and dissociating gas hydrates into the water column and atmosphere.

2. Background methane concentrations have been discovered in the water column in areas of the Okhotsk and Japan Seas without methane sources in the bottom sediments. The normal methane concentrations are as follows: 50-70 nl/l at the surface, 100-150 nl/l in the subsurface layer and decreasing up to 8-10 nl/l down to the bottom. In the deep sea of the basin of the Sea of Japan (depth 3000-3500 m), the methane concentration increases in the bottom water from a very low value (8-10 nl/l at a depth of less than 3000 m) to 50-60 nl/l at a depth of more than 3000 m (3000-3500 m). In this case, methane does not originate from deep layers of bottom rocks, but from the surface water. Usually, the background methane distribution changes in special whirlwind areas.

4. Methane can be used as an indicator of geological prognoses (oil and gas deposits, fault zones, seismic-tectonic activity, gas hydrates) and of tracer hydrology layers of the water columns.

5. The results of these investigations can be used to calculate the flux of methane into the atmosphere which contributes to the global climate change.

THE LAST MILLENIUM CLIMATE CHANGES AND RECONSTRUCTION OF THE LITTLE ICE AGE TIME BY THE BOTTOM SEDIMENTS OF THE ARCTIC LAKES

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Since 1993 the investigations of the deep tectonic arctic lakes have been carried out within the framework of the international projects "Eurasian Ice Sheet", "Laptev Sea System" and Russian investigations. These lakes are: Shel` in the Birranga mountains on Taymyr Peninsula, Lama Lake, Talikit Lake, Tonel Lake dissecting the Putorana Plateau and Bolshoye Schuche Lake on the Polar Ural. The short (up to 75 cm) cores of the bottom sediments were obtained from the mentioned lakes. The varvometric, pollen and diatomic analyses were used to define the last millennium climate changes of these regions and of the Little Ice Age (LIA) time. The magnetic susceptibility is determined and radiocarbon dating has been carried out for the core from Bolshoye Schuche Lake.

1. The LIA cooling appeared in all investigated cores and it carries two-phase features.

1.1 According to the received data on the core from Shel` Lake the LIA time is fixed by the temporary frames of 520-30 yr. BP and the coldest time is 290-250 yr. BP.

1.2. The time of LIA for Lama Lake is determined from 520 to 90 yr. BP and it is divided into two phases by the period of short warming (410-290 yr. BP). The cold maximum occurred at 160-90 yr. BP.

1.3. The upper cold maximum is revealed in the interval of 160-90 yr. BP for the core from Tonel Lake. In general worsening of the conditions for the development of vegetation was determined as falling to thetime frame of 520-90 yr. BP with a short warm phase at 410-290 yr. BP.

1.4. The upper cold interval is revealed from 100 to 40 yr. BP. The lower cold phase was determined at 440-320 yr. BP. This core is also divided by the warm time of 320-100 yr.BP.

1.5. The two phases of the cooling of LIA for the area of Bolshoye Schuche Lake are allocated in the intervals 350-270 and 220-90 yr. BP.

2. The periods of cooling and warming have an asynchronous character in various regions of the Russian Arctic.

NONCONSERVATIVE BEHAVIOR OF CALCIUM IN THE LENA DELTA AND LAPTEV SEA

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The behavior of calcium and magnesium was studied during the mixing of fresh and salt waters in the Lena Delta and Laptev Sea in November 1996 and September 1997.

During the studied periods, the Lena River was transporting calcium-carbonate waters, in which calcium/magnesium ratios exceeded the average sea water value 10 times, into the Laptev Sea. The calcium/magnesium ratios depend on the salinity variations in the Laptev Sea. This fact is explained by the influence of the Lena River on the major components of the Laptev Sea.

The behavior of calcium during fresh and salt water mixing was observed to be nonconservative. Calcium was removed in freshened water areas with a salinity of up to 10 ‰. The removal of calcium is explained by the sedimentation of the riverine colloidal form of calcium carbonate as a result of flocculation processes on the geochemical “fresh/salt water” barrier. The proposed hypothesis is confirmed by the estimation of the carbonate system. The waters of almost the whole mixing area are undersaturated by calcite. Despite of this, the surface layer of the bottom deposits in the southeastern part of the Laptev Sea contains about 1 % of $CaCO_3$, and only in the Lena Delta the concentration in the sediments reaches 3 %.

DOMINANCE OF OPPORTUNISTS? FEEDING ECOLOGY OF ZOOPLANKTON AS INDICATED BY FATTY ACID COMPOSITION

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The fatty acid and alcohol composition of the most important copepods concerning biomass and abundance on the Laptev Sea shelf (*Drepanopus bungei*, *Pseudocalanus* spp., *Acartia longiremis*, *Limnocalanus macrurus* and *Calanus* spp.) and of three amphipod species (*Apherusa glacialis*, *Gammarus wilkitzkii*, *Onisimus* cf. *caricus*) was determined to receive information about their feeding strategies and food composition. High amounts of the biomarkers 16:1(n-7) and 20:5(n-3) indicated a diatom-based diet of the mesozooplankton in late summer. The copepods could be distinguished into two opposing groups: while *Calanus* spp. was characterized by high amounts of long-chained lipid compounds (i.e. 20:1(n-9), 22:1(n-11) and 20:1(n-9)A, 22:1(n-11)A) indicating a predominantly herbivorous-based diet, the rest of the copepods was marked by the total absence of these molecules reflecting a more opportunistic feeding strategy. Possible reasons for the difference in feeding strategies are discussed.

METHANE FLUXES IN SIBERIA AND THEIR RELEVANCE FOR THE PERMAFROST-RELATED GAS HYDRATE RESEARCH

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Large amounts of gas hydrates are assumed to be conserved in the terrestrial permafrost (onshore and offshore) of the circumartic regions. Russian models of the permafrost thickness and the gas hydrate stability zone (GHSZ) indicate the existence of permafrost bonded gas hydrates in Siberia.

Our own field measurements show that Siberian permafrost landscapes like the Lena Delta are important methane sources. Methane is bonded in terrestrial and submarine permafrost compartments like wet soils, ice-rich sediments, marine sediments, ice wedges, ground ice and glaciers. The contribution of these sources to the global C-budget is still not well known. And only little is known about the stability and distribution of permafrost related gas hydrates.

First microbial laboratory experiments about the influence of the freeze-thaw cycle on the CH_4 production under low temperature and high pore pressure conditions show that recent gas hydrate formation is possible. Enough methane is formed by methanogenic archaea under anaerobic conditions and low temperature. During the re-freezing period this methane is captured and gets under high pressure of the upper and lower freezing front in the active layer. The results simulate the actual gas hydrate formation in surface-near permafrost layers under high freezing pressure conditions. During the thawing period the methane is partly oxidised to CO_2 by methanotrophic bacteria in the oxic permafrost layers. The site-specific methane oxidation determines the amount of the released CH_4 gas, which is controlled by the temperature and water regime. The investigation of actual CH_4 flux rates in the permafrost and further geomicrobiological experiments on the recent CH_4 hydrate formation will help to calculate the significance of this methane source. Carbon and hydrogen isotopic signatures will allow a better differentiation between CH_4 sources (biogenic or thermogenic CH_4) and alteration processes (different CH_4 formation pathways, CH_4 oxidation) and their significance for the recent gas hydrate formation. Knowledge about microbial processes is necessary for the estimation of the impact of possible climate and environmental changes on the methane turnover and the release from permafrost-associated CH_4 hydrates.

POTENTIAL FIELD ANOMALIES INTERPRETATION IN THE EURASIAN BASIN OF THE ARCTIC OCEAN

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The area of investigation includes the Nansen Basin, Gakkel Ridge, Amundsen Basin, Lomonosov Ridge, Submariner and Makarov Basins, Alpha and Mendeleev ridges.

The amplitude and frequency of the potential field anomalies were investigated using the double Fourier spectrum (DFS) analysis. DFS demonstrates the existence of separate groups of anomalies. The maps of partial gravity anomalies were computed as synthesis of harmonics of DFS. The correlation of the observed magnetic anomalies with the theoretical field generated by bottom elevations was also studied.

For the investigation of the gravity sources, a grid-approximation base was used that allowed computation of densities in the prespecified limits at a fixed geometry of the cross-section. These limits were set with the help of petrophysical data. Several transects were computed taking into consideration the existing seismic data.

The main geological results of the performed study are as follows:

- East from 75°E the Gakkel Ridge tectonic zone has a permanent width of about 160-200 km until it terminates against the base of the Laptev Sea slope. Potential field anomaly patterns in this part of the Gakkel Ridge are sharply discordant with respect to Nansen and Amundsen basins suggesting that the latter could not be formed by spreading from the Gakkel Ridge axis. This conclusion is supported by a lack of reliable correlation of the magnetic anomalies older than number 5, as well as by peculiarities of sediment thickness distribution in the Eurasian Basin.

- The Lomonosov Ridge displays an apparent heterogeneity. Its portions adjacent to the Eurasia and Greenland margins are underlain by a "normal" continental crust, while the basement of the central part of the ridge appears to consist predominately of basic magmatic rocks.

- The Alpha Ridge demonstrates some features of similarity with the western section of the Lomonosov Ridge. Both these areas are characterized by high values of correlation coefficient between the observed magnetic anomalies and theoretical anomalies attributed to bottom relief.

- The Mendeleev Ridge is also a heterogeneous structure, whose different parts display characteristics of continental crust.

NUTRIENTS IN THE LAPTEV SEA SYSTEM: DISTRIBUTION, VARIABILITY, AND BUDGETS

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Dissolved inorganic nutrients (nitrate, phosphate, silicate) have a great ecological significance in marine systems. They are a mineral basis for feeding of lower trophic level organisms, and, finally, the prosperity of the entire ecosystem depends on nutrient distributions and variability and the correlation between nutrients.

The aim of the report is to show the results of multiyear studies of nutrient distributions in the Laptev Sea within the framework of the Russian-German project “Laptev Sea System”.

The Laptev Sea is a region with highly variable physical processes, and with high and variable rates of primary production and organic matter recycling. Extreme environmental changes (pulsing river runoff, coastal erosion, weather and ice conditions, seasonality of biological processes) cause an extremely wide range of nutrient variability in space and time. The theory of structural zones and water mass formation is used to explain the complicated nutrient distributions and variability. The transport and transformation of substances, including nutrients, in different structural zones occur in different ways.

The results of the unique TRANSDRIFT expeditions allowed us to understand nutrient distributions at very important periods of the seasonal cycle (the Lena River break-up in spring, freeze-up during autumn, winter conditions in the Great Siberian polynya) and to update our database that was used for nutrient budget calculations according to LOICZ recommendations.

Budgeting results show that the entire Laptev Sea shelf system acts as a net sink of dissolved inorganic phosphorus (DIP) and nitrogen (DIN), while the bottom layer serves as a net source of DIN. The system is net autotrophic, exclude the bottom layer in winter, and it is also a net nitrogen-fixing system in both summer and winter.

HOLOCENE CHANGES OF RIVERINE DISCHARGE AND SURFACE WATER SALINITY IN THE LAPTEV SEA INFERRED FROM DIATOM ASSEMBLAGES

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The present state of the Arctic Ocean and its influence on the global climate system strongly depend on the freshwater supply as a major function of sea ice formation and circumarctic ocean circulation. From this point of view, the Laptev Sea, constituting the central part of the wide Siberian shelf of Eurasia, is of key importance for freshwater and sea ice supply to the Arctic Ocean due to high continental river runoff during summer and sea ice formation during the winter time. By evaluating the modern distribution patterns of diatom assemblage composition against surface summer water salinity we reconstructed the Holocene development of riverine discharge into the Laptev Sea as well as the surface water salinity. For this purpose, we used three cores (PM9482-2, PS51/92-12, and PS51/135-4) from the southeastern part of the Laptev Sea obtained during the Russian-German

TRANSDRIFT expeditions. Determination and correlation of the main hydrological events is based on AMS^{14}C chronology.

As a result of postglacial sea level rise, the shallow Laptev Sea shelf was rapidly flooded during the Holocene causing a dramatic change in overall depositional environment. Diatom analyses of the lowermost part of te core PS51/135-4 which is the northernmost core studied (modern water depth 51 m + 5.1 m core depth), within the Yana River paleomouth, give evidence of "avalanche-like precipitation" of freshwater diatoms. This high abundance of freshwater diatom sedimentation is typical for a depocenter of the inner shelf zone. Furthermore, their relative abundances indicate a salinity of <5 psu for the time >11 ka BP. The following rapid increase in sea-level caused the further southward migration of depositional centers carrying high contents of riverine-derived organic matter, which is evidenced by high concentrations of freshwater diatom valves in the lowermost part of core PS51/92-12 (modern water depth 32, core depth 5-6 m) from near the Lena River paleomouth. Thus, for this inner shelf region the interval between 11 and 7.4 ka BP was the time when salinities remained <5 psu due to the proximity of the Lena River.

For the time after the sea level reached its highstand at about 5 ka BP, variations in the fluctuations of near-coastal riverine discharge, surface water salinity, and sea-ice regime can be reconstructed using specific diatom assemblage groups. Especially near the modern Lena Delta (cores PM9482-2 and PS51/92-12), there is ample evidence for variable conditions in all of these three environmental factors. Although the forcing mechanisms for these variations remain speculative at this time they probably are related to large-scale changes in ocean-atmosphere circulation patterns of the Arctic.

THERMAL SIGNALS ASSOCIATED WITH SEAFLOOR HYDRATE ACCUMULATIONS AND APPLICATION FOR INVESTIGATIONS IN THE SEA OF OKHOTSK

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Recent hydrate research efforts have been shifting from deeply located hydrate accumulations to near-surface occurrences. More and more spectacular findings of shallow hydrates have been reported (1000 kg off Vancouver, 50kg off Oregon and first samples in Lake Baikal) and experts start to consider them as a promising commercial deposit (Hovland, 2000). In addition, they play an active role in the still poorly known methane budget at the seafloor (Kvenvolden et al., 2001). Little, however, is known about the extent of near-surface hydrate deposits, and most geophysical techniques still fail to serve as a reliable detection method. We propose that a traditional heat flow probe is a useful tool to detect new locations of near-surface hydrate deposits, to delimit their extent and to constrain possible formation mechanisms.

Hydrate accumulations at the seafloor appear to be restricted to areas of focussed fluid discharge (Ginsburg and Soloviev, 1998). Fluid discharge with gas venting at the seafloor has been observed in different forms, ranging from cold seeps (e.g. Baikal) to expulsive mud volcanoes (e.g. Haakon Mosby). All these fluid discharge features appear to be associated with significant near-surface thermal anomalies, in general expressed as concentrical shapes not larger than several kilometers. Therefore, detecting such local heat flow anomalies can be considered as an important step in detecting seafloor hydrate accumulations, too.

Delimiting the extend and maxima of the thermal anomaly will provide further information on the mode of focussed fluid migration and associated mechanisms of potential hydrate formation. In gas seepage denoted as cold vents, the primary mode of fluid migration is probably gas diffusion or free gas flow. These vents appear to be associated with relatively small magnitude thermal anomalies (e.g. in Baikal: maxima of 150-200 mW/m^2). The gas diffusion migration process will result in lenticular-bedded and porphyraceous hydrate deposits formed within the limits of a diffusion halo by water segregation (Soloviev and Ginsburg, 1997). Ascending fluid flows in mud volcano, on the other hand, have smaller gas content and are associated with very strong local heat flow anomalies (e.g. in Haakon Mosby: up to >1000 mW/m^2). In these vent systems, gas hydrates are suggested to be formed in first instance by precipitation from infiltrating gas-

saturated water (Ginsburg et al.,1999). This mechanism will produce more massive hydrates with a distribution delimited by specific hydrate stability conditions around the vent.

Beside the thermal anomaly resulting from the venting, additional anomalous thermal signatures at the surfaces are expected to result directly from the shallow hydrate accumulation. Firstly, hydrate formation is an exothermic process, releasing a lot of heat and changing near-by temperature distribution (e.g., Soloviev and Kaulio, 1999). Secondly, the composite thermal conductivity of the hydrate-bearing sediments is expected to be different than the original sediment mass, resulting in thermal effects such as heat flow focussing and defocussing around the deposit (Lerche, 2000). In addition, the thermal conductivity of near-by sediments will also be altered by processes such as water segregation involved in the hydrate formation. However, these thermal signals are relatively small; and at present, little field analysis on the matter is available.

Several gas seeps in the Sea of Okhotsk are also known to be sites of gas hydrate accumulations. The gas venting sites have been largely studied during numerous KOMEX cruises, and many data on seepage distribution, setting, geochemistry of pore water and sediments and gasemission variability have been collected. However, the mechanism of hydrate formation and the extent of the hydrate deposits still are not well known. A detailed heat flow investigation of the gas seeps on the northern Sakhalin slope can help to furtherly constrain the existing hypothesis' on hydrate formation and occurrence. New heat flow data will also provide better limits on the active seepage areas in the Derugin Basin.

THE ROLE OF DEEP FLUIDS IN MAGMA GENERATION IN THE KURILE-KAMCHATKA ARC: AN OVERVIEW OF GOALS, APPROACHES AND RECENT RESULTS OF KOMEX SUBPROJECT 2

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The project is focused on the reconstruction of the role of deep fluids in magma generation processes within the geodynamic framework of the complex subduction system of the Kurile-Kamchatka Arc. The expected outcomes of the study are a gain of fundamental information on the magmatic component in the material cycles in subduction zones, accurate estimates of the climatic impact of subduction-related volcanism and a contribution to a model for the geodynamic evolution of marginal basins by the reconstruction of tectonic, volcanic and magmatic processes in the Kurile Basin. These objectives are to be achieved by a multidisciplinary approach including volcanological, petrological and geochemical investigations on submarine volcanic structures in the Kurile Basin and of volcanic rocks and magmatic inclusions in minerals from various tectonic environments in Kamchatka.

The collection of volcanic rocks of Kamchatka sampled in 2001 during the first land expedition within the KOMEX project provides a reliable basis for the planned research. This includes 270 samples from 3 major areas representative of different tectonic situations within the presently active arc: (1) the most northern Kamchatka volcano, Nachikinsky, and basaltic cinder cones near the junction of the Aleutian and Kamchatkan arcs; (2) the Late Miocene – Pleistocene volcanogenic complex in the field of Left Zhupanova River (Eastern Kamchatka) tracing initiation of magmatic activity in the present eastern volcanic front; (3) the transect of the South Kamchatka arc, representative of a 'normal' island-arc tectonic regime unaffected by the other tectonic factors.

The first data obtained within the project can be summarized as follows:

1. It was found that the liquidus assemblage of the magmas in South Kamchatka is composed of olivine Fo85-86 and relatively low-Cr spinel with Cr#40-50, which are significantly less refractory compared to olivine (Fo90-93) and Cr-rich spinel (Cr#70-80) in the lavas from north Kamchatka. The observed difference seems to require the existence of compositionally different mantle domains beneath Kamchatka and/or a systematic variation in the mantle melting pressure along the arc.

2. Major and trace element concentrations in basalts from Nachikinsky, the most northern Kamchatkan volcano, demonstrate that the rocks are unlike any of the Kamchatka island-arc basalts. The major element compositions of the rocks correspond to high-alumina basalts, but abundances of trace elements are more typical of OIB-type magmas as testified by the coupled enrichment in Ti , Ba, Zr, Nb, Na and K. The origin of the magmas is likely to be related to low-degree pressure-release melting in response to local extension along the strike-slip faults at Kamchatka-Aleutian junction. Alternatively, the melting of the edge of a torn subducted slab can not be excluded.

3. Preliminary data on the chemistry of rocks from South Kamchatka do not support a systematic variation in the degree of partial melting across the arc. Instead, concentrations of alkaline elements mobile in subduction fluids vary strongly and show a general increase towards the back-arc. The latter seems to indicate enhanced solubility of alkalis in fluids released at deeper parts of the downgoing subducted slab.

NEW APPROACH IN THE FIELD OF TRAINING SPECIALISTS FOR THE SOLUTION OF PROBLEMS OF BIG CITIES AND INDUSTRIAL ZONES

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The intensive development of industrial production, the growth of cities and industrial zones and, consequently, the appearance of serious geoecological problems have caused the necessity of elaboration of a new approach for training specialists in this area.

The water supply and water consumption in cities, cleaning of communal and industrial waste waters are the most urgent problems. Lately a shortage of specialists in the field of management has been made itself felt in big cities and industrial zones. The concept of sustainable water resource management can be a basis for stable public development.

The master's course "Sustainable water resource management" covers a broad spectrum of problems in this area. Management matters for river basins, shores, underground waters, water resources in various industrial spheres are taken into consideration in the course. Sections on water legislation and other legal acts are included therein. Such an interdisciplinary approach enables students to solve water resource problems in various fields of their future professional activity irrespective of their specialization.

The course can be implemented on the basis of the following trends: *Hydrometeorology*, *Geoecology and Nature Management*, *Geography*, which are licensed at the Geography and Geoecology Faculty of the St. Petersburg State University. The experience of conduction of such a course within the framework of the international division of Baltic and Arctic projects is attached.

SPECIES AND ABUNDANCE CHANGES OF BENTHIC FORAMINIFERA IN CORE LV27-2-4 (FAR NW OKHOTSK SEA)

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The benthic foraminifera species composition and abundance were studied in core LV27-2-4 recovered from the far northwestern part of the Sea of Okhotsk (water depth 1305 m).

The age model of the core is based on isotope-oxygen stratigraphy, carbonate stratigraphy and magnetic susceptibility. The species diversity of benthic foraminifera (BF), their number and percent content were studied. Data on the content of carbonate and organic carbon, opal, ice rafted debris (IRD), and the results of diatom and radiolaria analyses were used as well in order to reconstruct the paleo-conditions. Preliminary results are obtained.

The boundaries of the BF assemblages (590 cm, 500 cm, 430cm and 330 cm) correspond to the main changes of the environment in the NW periphery of the Sea of Okhotsk during Late Quaternary.

During the termination of the last glaciation T1A (590-500 cm), the BF number sharply increased; in the complex, *Uvigerina peregrina Cushman*, *Valvulineria ochotica Stschedrina* (warm-water) and *Cassidulina delicata Cushman* and *Brizalina spissa Cushman* predominate, which are characteristic for high-productive areas of the modern ocean. Such BF changes and high IRD values are consistent with the beginning of summer ice melting and productivity growth.

A sharp decrease of the BF number and an *Alabaminella weddelensis Earland* appearance in addition to the previous assemblage were observed in interval 500-430 cm; and they are consistent with the global Younger Dryas cooling.

The interval 430-330 cm (termination 1B) assemblage was marked by an increase of the BF number. *B.spissa Cushman* prevailed in the assemblage, and warm-water species played a prominent role as well. The IRD peak, changes in BF number and species spectra showed a significant warming in the studied area with summer ice melting and productivity growth during the final phase of deglaciation.

COASTAL PROCESSES AND THE SEDIMENT BUDGET OF THE LAPTEV SEA

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The extensive circum-arctic coastal margin, about 200,000 km long, is the interface through which land-shelf exchanges are mediated. Determining sediment sources and transport rates along high latitude coasts and inner shelves is critical for interpreting the geological history of the shelves and for predictions of future behavior of these coasts in response to climatic and sea level changes.

During the last four years our investigations focused on land-ocean interactions in the Laptev Sea and from 1998 to 2001 four expeditions to the coastal region were carried out. In particular, our studies concentrated on (a) the reconstruction of the sedimentation history of the Lena Delta and its role as a modern and fossil accumulation area, (b) the quantification of the sediment input to the Laptev Sea through coastal erosion and (c) the assessment of the sediment budget of the Laptev Sea. The results can be summarized as follows:

(a) The Lena Delta is a composite of erosional remnants of Ice Complex deposits and fluvial and deltaic sediments of Late Pleistocene to Holocene age. The actual delta sedimentation started after the sea-level had reached its modern position ca. 6.000 y before present. Today the Lena Delta acts as a filter for river bedload but it does not store considerable amounts of the river suspended load.

(b) The average shoreline and cliff top retreat rate for all Laptev Sea coastal sites, which consist of ice-rich sediments, is approximately 2-2.5 my^{-1}. The maximum rate of coastal erosion was observed on the northern cape of Muostakh Island: 650 m during 48 y or 13.5 my^{-1}. The obtained data indicate that the sediment input to the Laptev Sea by rivers and shores is of the same order but probably coastal erosion sediment input is considerably larger than riverine sediment discharge.

(c) A quantitative estimation of the sediment budget of the Laptev Sea during the last 5.000 y shows that sediment input (river supply and coastal erosion) and sediment output (sea-ice export, bottom sediment transport and sedimentation in the Laptev Sea) can be well balanced. The most interesting conclusion concerns the sediment budget of the Arctic Ocean: the total coastal erosion sediment input of ca. 430 x 10^6 tyr^{-1} is almost twice as high as the total riverine suspended matter discharge of ca. 230 x 10^6 tyr^{-1}. Although the coastal erosion data are best estimates and comprise a considerable error (except for the Laptev and East Siberian seas, which are more or less well studied), this finding indicates that coastal erosion is one of the main processes which control the sedimentation in the Arctic Ocean.

Outlook:

(1) circum-Arctic investigations of coastal dynamics as a function of environmental forcing, coastal geology and geocryology and morphodynamic behavior;

(2) the Laptev Sea coastal area as a natural laboratory to investigate the dynamics of permafrost and its spatial and temporal variability.

RECONSTRUCTION OF VEGETATION AND CLIMATE SITUATION IN THE NORILSK LAKES REGION, PUTORANA PLATEAU, FOR THE LAST MILLENNIUM ACCORDING TO POLLEN DATA

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During the pollen analysis of the arctic lakes from the Putorana Plateau (Lama Lake, Tonel Lake and Talikit Lake) new data on climate variations and vegetation changes were obtained for the last millennium. The cores of the bottom sediments were analyzed in terms of pollen and spore contents with the length of cores of up to 50–80 cm. The samples from the cores were taken continuously.

The bottom sediments are represented by the varves with some layers of sand and gravel. The varvometric analysis was carried out in order to calculate the pairs of the layers formed each year. It also made it possible to evaluate the sedimentation rates.

Comparing the results of the varvometric analysis and spore and pollen analysis the cooler and warmer periods were defined for the past thousand years for the region of study. The conclusions about vegetation and climate changes were drawn with respect to the modern vegetation and climate state of the region.

In all the cores two maxima of cooling, interrupted by two warmer periods, are represented. Thus, the upper and the lower maxima of cooling in Lama Lake are defined for the time period of 90-160 years ago and 690-730 years ago according to the decrease of the Aboreal and shrub pollen in the spectra, including the low content of the pollen grains in the samples. The warmer periods refer to the time 290-410 years ago and 410-520 years ago. These conclusions are based on the domination in the spectra of the Aboreal and shrubs vegetation, mainly alder and birch.

The upper maximum of cooling from Tonel Lake is well seen in the time interval of 50-120 years ago. This fact is rested on the practically complete absence of the pollen grains in the samples from these depths. The lower maximum is not so distinct but it is determined according to the minimum content of birch pollen during 530-640 years ago.

The upper cooler period from Talikit Lake is marked at the timespan of 40-120 years ago and its lower maximum is referred to 530-640 years ago. At the depths corresponding to these dates a decrease of the aboreal pollen is revealed, whereas the content of herbs increases.

Therefore the regularity of cooling of the climate conditions is traced in all the cores.

The upper one is the most certain one for each core and falls to the last hundred years.

PLEISTOCENE SEDIMENTATION AND SEDIMENT TRANSPORT ON THE LAPTEV SEA SHELF AND CONTINENTAL SLOPE

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The veneer of Holocene sediments on the Laptev Sea shelf and slope is unusually thin and does not exceed 1-5 m in the western and 3-5 m in the eastern part of the area. This may be due to the existence of a network of paleovalleys accounting for the transport of clastic material across the shelf, or it may represent the consequence of recent erosion. Interpretation of HRS data acquired during the last decade allowed to reconstruct in detail the network of paleorivers and recognize three systems of different ages. A digital IBCAO data set was used to construct 3D seabed images. In the course of the subsequent

geomorphologic analysis the areas characterized by different depositional environments were outlined and described.

The most reliably traced paleochannels on the shelf form a complicated network that controlled the sediment transit routes during at least the last 100 Ka. Radiocarbon dating of the sediments that overlap the most ancient segments of paleovalleys suggests that the youngest generation of paleochannels was formed in Late Weichselian time. Two older generations are conventionally attributed to the early Weichselian and Middle Pleistocene epochs.

Numerous underwater canyons detected on the continental slope are not directly linked to the shelf paleoriver network, which may be explained by tectonic elevation in early Holocene time of the present-day shelf edge. The continental slope and its foot are floored by sedimentary sequences of several age generations, and the most intensive contemporary movements occur along the buried continuation of the Gakkel Ridge rift valley. The features produced by such movements are conspicuous in the modern relief of the shelf edge and can also be traced at the "interceptions" of submarine paleovalleys.

From the analysis of seismic facies the relationships of various depositional forms were revealed and allowed to recognize four stages of development of the shelf differing in character of sediment transport. A cyclic nature of sea level oscillations was established corresponding to that described for the end of the Middle Weichselian-Holocene. The influence of the supply of sedimentary material from the Laptev Sea shelf was established as far as more than 550 km from the present shelf edge, i.e. more than 1100 km away from the modern shoreline. Several sedimentary strata generations of variable age are also apparently present in the deep seabed area where they probably mark successive fluxes of sediment material across the shelf.

ENVIRONMENTAL CHANGES AND CATASTROPHIC COLD EVENTS AFTER THE LAST GLACIAL EXTREME, LAPTEV SEA REGION

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The region under investigation includes coastal lowlands, the shelf of the Laptev and the western part of the East Siberian Sea and the Novosibirsky archipelago islands. During the Late Pleistocene and Holocene, a glacial-eustatic sea regression took place in this region. During the period between 24-18 ka B.P., the recent arctic shelf down to isobath 120 m was dry land. Permafrost on the shelf and lowlands was progressing. The ice-rich syncryogenic deposits of the Ice Complex (IC) on both shelf and lowlands were also developing during this time of sea regression. Thickness of IC-rich sediments is 80 m and the total ice content is 80-90%. At the end of the Late Pleistocene (approximately 12.8 ka B.P.), the formation of thaw lakes on the ice-rich deposits of IC started. As a result, during the Holocene the transgressing sea submerged the arctic shelf covered by numerous thaw lakes and alases. The latter were transformed into bays named by the authors "thermokarst lagoons". The winding and total length of the sea shores was enlarged by many times, increasing the total effect of shore thermoerosion. As a final result, the rate of sea transgression grew dramatically. For example, between 9 kya B.P. and now, the shoreline moved southward in the Laptev Sea by 300-400 km and in the East Siberian Sea by 800-900 km. At the same time, most of the mineral and organic matter from the Ice Complex destroyed by the sea remained on the bottoms of the thaw lakes and "thermokarst lagoons" and did not appear on outer shelf and continental slope (Bauch et al., 1999; Romanovskii et al., 2000). Sea penetration into "thermokarst lagoon" shores led to the formation of IC island archipelagos. Lake taliks on the sea floor transformed into submarine ones. At places where IC islands were razed by shore thermoerosion, the shallows with an "ice floor" now exist. "Ice floor" shallows now are affected by processes of permafrost thawing under the influence of the seasonal oscillation of water temperature (Dmitrienko et al., 2001) and consequent "bottom thermoerosion". Recently the rate of permafrost thawing in such places is approximately 0,5 m per year. Mathematical simulation of the lake taliks formation showed that its recent depth is less than 100-150 m. As a result of the processes described above, the offshore

permafrost table on the shelf is very uneven. The relict permafrost table lowers to 100 m below the former lake taliks and rises within the

former IC islands. Shoals with "ice floor" covered only by a thin layer of cryotic marine sediments are recently wide spread on the shelf of the eastern part of the Eurasian Arctic seas. On the main part of the shelf, where sedimentation of marine deposits take place, the permafrost table position is at the depth of 10-15 m below the sea floor. The environmental events described above created an ecological catastrophe at the end of the Late Pleistocene and during the Holocene. A huge area of the eastern part of the Eurasian shelf was submerged by seas; the unique landscape of tundra-steppe was destroyed; the complex of "mammoth fauna" perished (Sher, 1992). The natural events described above promoted the destruction of the "Bering Land Bridge" and created significant obstacles in the way of population migration between Eurasia and North America. First results of the typical "thermokarst lagoon" investigations have been obtained. Fresh water lake sediments salting process below "thermokarst lagoon" situated in Bykovsky Peninsula are recently under investigation.

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ON THE IMPORTANCE OF FORAMINIFERA OF THE GENUS RETROELPHIDIUM FOR PALEOGEOGRAPHIC AND PALEOFACIES RECONSTRUCTION

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The family Elphidiidae, whose time of existence covers an interval from the Neogene up to our time, is one of the most numerous, widespread and morphologically various among foraminifera. Representatives of this family, in particular, species of the genus Retroelphidium, meet in various facies environments - from desalted shallow lagoonal up to comparatively deep-water normally salty basins. It is with Elphidiidae that the greatest quantity of the questions at issue concerning systematization and classification of separate genera and species is connected. For this reason they draw the attention of the micropaleontologists, trying to study their complex structure, to classify, and to reconstruct by them paleogeographic and facies conditions of this or that basin.

At the present time, thanks to detailed studying of the morphology and a nature of pontines, the system of internal channels and to the structure of the wall, a line of genera is defined for the family of Elphidiidae: Elphidiella Cushman, 1936; Cribrononion Thalmann, 1947; Cribroelphidium Cushman et Bronnimann, 1948, Protelphidium Haynes, 1956; Retroelphidium Voloshinova, 1970; Haynesina Banner et Culver, 1978 and others. But at some researchers tend to unite some genera of this family in the united genus Elphidium, or Cribroelphidium is traced, which is represented to us incorrectly.

We would like to draw attention to the representatives of the genus Retroelphidium who are the most widespread in foraminifer assemblages of the Russian Arctic regions (and particularly the Laptev Sea), making up not less than and sometimes more than 50%. The rather difficult diagnostics of the species of the genus Retroelphidium results in the fact that many researchers frequently define its representatives as the united species *Elphidium clavatum* Cushman or *Elphidium excavatum* (Terquem) with varieties

(*E. clavatum/excavatum*), alluding to the considerable morphological variability of this species which is connected with various geographical distributions and ecological conditions. Such a too wide interpretation of the species make impossible to use it for paleofacies and paleogeographical reconstructions. In case this group of species is interpreted as the united species *E. clavatum/exclavatum*, geographical distribution of such a species envelops all northern hemisphere, and the abiotic parameters of the basin for it vary in a wide range; depths are from 3 up to 400 m, temperatures are from negative to high positive ones and salinity is between 18 to 35‰. The stratigraphical position of such «combined» species will occupy a large interval from the Miocene to the present time.

Holding the opinion of Gudina and Levchuk, we are inclined to consider morphological differences not as eco-phenotypical or subspecies, but as species, defining within the limits of the genus Retroelphidium the species *R. subclavatum, R. atlanticum, R. boreale, R. hyalinum, R. obesum, R. propinguum* and also *R. jachimovichi* sp. nov. (the species is defined by Tverskaja). The independence of these species is confirmed not only by accurate morphological differences and stratigraphical position, but also by the connection to a certain geographical and ecological environment. Consequently accurate differentiation and definition of the species may porvide important material for the reconstruction of abiotic parameters of the basin of the past.

POSTGLACIAL ENVIRONMENTS ON THE EASTERN LAPTEV SEA SHELF: EVIDENCE FROM DIATOM AND AQUATIC PALYNOMORPHS ASSEMBLAGES

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So far, the Pleistocene geological history of the Laptev Sea shelf was reconstructed mainly on the basis of high-resolution seismic data and their extrapolation to the terrestrial geology (e.g., Alekseev et al., 1992; Drachev et al., 1995; Kim et al., 1999; Kleiber and Nissen, 2000). Due to successful realization of the drilling program executed by the Russian-German expedition TRANSDRIFT VIII in 2000, the uppermost part of last glacial sediments were recovered from the Eastern Laptev Sea. Our environmental reconstruction using these sediments from the Eastern Laptev Sea is based on detailed investigations of diatom assemblages and palynomorph remains, i.e., marine (dinoflagellate cysts, acritarchs, foraminifera linings) and freshwater (chlorophyte cysts, pollen and spores).

The borehole KI005 used in this study was obtained from the eastern Yana River paleodelta channel from the water depth of 42 m. In this borehole sediments were recovered from approximately 8 m to 16 m below the sea floor. The lower part of sequence is represented by frozen sediments. The upper part of the sequence (8 – 11.8 m) is represented by mainly sandy-silty sediments. The total concentration of diatom valves, dinoflagellate and chlorophyte cysts, as well as other aquatic palynomorph remains in these sediments is very low. However, the following results concerning sedimentation environments can be emphasized. Relatively high abundances of dinoflagellate cysts (30-92%) and marine diatoms (up to 95%) give evidences on marine environments during the time accumulation of studied sediments. It is confirmed by occurrences of other marine microfossils (acritarchs, foraminifera lings). At the same time, high variability in ratios of marine/freshwater diatoms and dinoflagellate/chlorophyte cysts indicate unstable hydrodynamic conditions, which were possible caused by variabilities in riverine discharge and sedimentation in the zone of intermixing between river and marine waters. The uppermost part of investigated sediments (0-50 cm) is characterized by a predominance of marine microfossils, which indicate inner shelf environments.

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INTERACTIONS BETWEEN COLD-SEEP AND DEEP-SEA ECOSYSTEMS ON THE SAKHALIN CONTINENTAL SHELF AND SLOPE AND IN THE DERUGIN BASIN (SEA OF OKHOTSK)

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In the Sea of Okhotsk, gas venting has been discovered on the Sakhalin shelf and slope as well as fluid flow in the Derugin Basin. The sediments at or near the seep sites were inhabited by filamentous bacterial mats (cf. *Beggiatoa* sp.), pogonophoran tubeworms (*Siboglinum plumosum*) and bivalves (*Calyptogena* aff. *pacifica*, *C. rectimargo*, *Archivesica* sp. / Vesicomyidae, *Conchocele disjuncta* / Thyasiridae, *Acharax* sp. / Solemyidae). Pogonophoran tubeworm species (Sclerolinidae) harbored the fluid channels in the authigenic barite edifices in the Derugin Basin. The seep sites are located in close proximity to each other at water depths between 160 to 1600 m and, thus, provide an excellent area to study depth-related distribution patterns. The number of chemoautotrophic species increased with water depth. Seep macrofauna did not occur in depth < 360 m. This pattern coincided with a distinct increase in the abundance of large megaepifaunal predators (crabs, asteroids, gastropods) strongly suggesting that predation is a limiting factor for seep species distribution. Furthermore, the occurrence of seep species is influenced by sediment grain size.

Photographic investigations revealed that the megaepifaunal distribution was correlated with both water depths and the presence of hard substrates. At similar water depths, there was no significantly higher abundance of predators at seeps than in non-seep areas. This fact indicates that chemoautotrophic primary production does not contribute significantly to the benthic biomass at the Sakhalin shelf and slope or in the Derugin Basin.

HYDROACOUSTIC FLARE IMAGING AND ESTIMATION OF THE METHANE FLUX FROM AN ACTIVE NATURAL METHANE VENT AREA ON THE NORTHERN SAKHALIN SLOPE

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The results of underway hydroacoustic flare imaging surveys in the Okhotsk Sea obtained by using standard shipboard echosounders during the joint cruises of the Russian-German project KOMEX on Russian research vessels in 1998-2000 are presented. The signal reflected from water anomalies was digitized, processed and recorded by means of the acoustic registration system UDM developed by POI. Most successful were the extensive summer surveys: RV Lavrentiev, 1998, fish finding echosounder SARGAN, 20 kHz, about 200 flare events, and MV Marshal Gelovany, 1999, echosounder GEL-3, 12 kHz, 62 flare events. Detailed maps and catalogs of already known and new flares were prepared. All observed flares occupy a narrow strip along the northeastern Sakhalin shelf and slope at a

longitude near 144 E and latitudes from 47 to 56 N. The water depths vary from 45 to 1000 m.

It is still impossible to directly calculate the gas flux from flare image data as the flare mapping still is too sparse, the acoustic system has not been not calibrated and the real bubble spectrum is unknown as well as bubble floating and dissolution velocities, which can be strongly affected by a possible presence of gas hydrates or organic films on the surface of the bubbles.

In the most detailedly investigated methane venting area on the northern Sakhalin slope, supplying methane from destabilized gas hydrates (Obzhirov and Gizelle flare area), a number of active flare bodies was crossed several times and sampled for hydrochemical water analyses. This allows to obtain 3D shapes of flare bodies, show their connection with the water current and establish a correlation between flare intensity and methane concentration, transparency and other hydrochemical characteristics such as oxygen.

SIBERIAN PERMAFROST AS PALEOENVIRONMENTAL ARCHIVE - NEW RESULTS AND NEW PERSPECTIVES

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The Siberian lowlands are characterized by widespread permafrost. The syngenetically formed permafrost sequences are excellent terrestrial climate archives and a supplement to the global long-dated marine, glacial and lacustrine records of the regions between Pacific, Atlantic, Arctic Ocean, the Greenland ice cap and the Lake Baikal. Multidisciplinary records of sedimentology, biogeochemistry, geocryology**,** geomorphology, geochronology, paleobotany (seeds, pollen), palaeozoology (insects, mammals, rhizopods, ostracods), stable isotopes and hydrochemistry of ground ice can be combined to reconstruct the complex Late Quaternary arctic environment. The main results of our paleo-environmental studies are: (1) the oldest permafrost deposits with ice wedges are dated at ~200 ka; (2) significant permafrost degradation occurred in a warm stage >50 ka; (3) tectonically caused facies changes are found at about 50-60 ka and 50-150 ka; (4) tundra-steppe bioms characterize the Late Pleistocene arctic environment; (5) the Late Pleistocene climatic fluctuations are mainly caused by variations in continentality and (6) the Late Pleistocene-Holocene transition is evident in all records. The results yield new evidence for the very special conditions in non-glaciated shelf areas in the Northeast Siberian Arctic and an improvement in the modelling of permafrost dynamics during the Quaternary.

Based on the present results, in the next years our studies in Northeast Siberia will focus on (1) the reconstruction and dating of older (up to Middle Pleistocene) permafrost dynamics especially during strong environmental changes; (2) the modelling of cryogenic processes (permafrost degradation and formation); (3) the reaction of biocenoses during the Late Pleistocene-Holocene climatic change; (4) the use of ice wedges as paleo-thermometers and the monitoring of ice wedge formation; (5) the reconstruction of the assumed circulation patterns in the Late Pleistocene arctic atmosphere using the stable isotope composition of ground ice; (6) remote sensing of the periglacial landscape and its reconstruction for the Late Pleistocene and Early Holocene; (7) the greenhouse gas capacity of Quaternary permafrost deposits.

In general, the studies of permafrost dynamics during the climatic cycles of the Quaternary period since Marine Isotope Stage 6 will focus on regional, facial and temporal environmental gradients in terrestrial permafrost sequences and periglacial landscapes of the coastal lowlands around the Laptev Sea and the New Siberian Islands.

METHANE IN SURFACE SEDIMENTS OF THE HAAKON MOSBY MUD VOLCANO

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The Haakon Mosby Mud Volcano is located in the Northern North Atlantic. Enhanced thermal gradients, bacterial mats, and occurrence of gas hydrates are reported for this mud volcano. During a cruise with the French research vessel "Atalante" bottom water composition, geochemistry of surface sediments, and microbiology of bacterial mats were studied by several dives with the ROV *Victor 6000*. The spatial distribution of bacterial mats was quantified by combination of video tracks, mosaiking technique and application of Geoinformation Systems. Surface sediments derived by push coring in bacterial mats, the center and the rim of the mud volcano are characterised by a considerable difference in methane concentrations. The transfer of methane and nutrients from the seafloor to the bottom water was studied by high-resolution bottom water sampling. Furthermore, bottom water currents were measured. The combination of these different attempts allows detailed consideration of the production and consumption of methane in sediments and release of methane to the lower water column.

THE LAPTEV SEA ECOSYSTEM RESEARCH: NOW AND THEN!

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(with contributions from project participants)

Climate change and the Arctic Ocean have been the interest of many international and national research projects. The "Laptev Sea System" project considered relating questions from various scientific viewpoints including oceanography, marine chemistry, geology and biology. The main foci of the biological research drifted from a more descriptive approach (then) to process-oriented questions (now).

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

Already early in the year phytoplankton production is possible in the polynya region of the Laptev Sea, which is dividing the fast and sea ice from east to west app. 200 km north of the Lena Delta. Hence this all the year round ice-free water is very important for all biological processes.

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

KIHZ III. THE HIGH RESOLUTION MULTI-PROXY-PARAMETER NETWORK AND SYNTHETIC TIMESCALE IN KIHZ (NATURAL CLIMATE VARIATIONS IN THE HOLOCENE)

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The KIHZ research project incorporates all available palaeoclimate data, both prehistoric and historic, from a variety of high-resolution continental and marine archives. These include, for example, European varved lake sediments, N-GRIP ice cores, German dendrochronology, Red Sea and Bermuda coral records, and laminated marine sediments. Of fundamental importance for the combination of data analysis with numerical modelling is the construction of a synthetic time scale on a calendar year basis.

In order to reconstruct the Holocene climate more precisely and to integrate more regional details with higher temporal resolution, we have used a multi-proxy approach. The databank (PANGAEA/or files on a ftp-server) contains all raw proxy data together with related information and evaluated palaeoclimatic data. In addition, we also use published data from other sources, for example, the World Data Center for Paleoclimatology (Boulder, Colorado).

An initial attempt at the construction of a synthetic annual timescale has been based on the varve chronology from the Eifel region (Central Europe). The Eifel region timescale includes two isochrones - the Ulmener Maar Tephra (UMT) at 11.000 vy.BP (varve year before 1950 AD) and the Laacher See Tephra (LST) at 12.880 vy.BP. Correlation of the Eifel chronology with other palaeoclimate archives, for example, ice cores, dendrochronological records, varved lake sediments, has been initiated. There are, however, significant problems inherent in attempting such a broad-based correlation. It is intended that multi-proxy parameter networks will be established for each palaeoclimate archive type for the Holocene period.

GASGEOCHEMICAL RESEARCH OF MUD VOLCANOES ON SAKHALIN ISLAND

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In summer 2001, gasgeochemical research was carried out in three areas of mud volcanic activity on Sakhalin Island. At South Sakhalin Mud Volcano, spontaneous gas was tested, and gasgeochemical, hydrochemical and temperature parameters were monitored. At Pugachyovsky and Daginsky Mud Volcanoes, gasgeochemical sampling was made. The results are given below.

Spontaneous gas taken from several sampling points of South Sakhalin Mud Volcano had the following components: CO_2 – from 39 to 94,6 %, CH_4 – from 1,71 to 31,74 %, O_2 – from 0,2 to 7,4 %, N_2 – from 2,8 to 27,7 %. Contents of heavy hydrocarbons were as follows: C_2H_6 – 3758 ppm, C_3H_8 – 401,6 ppm, C_4H_{10} – 104 ppm, C_5H_{12} – 22 ppm. In comparison to the data given by other researchers, an increase of the content of CO_2 in ratio to the content of CH_4 was revealed inside the spontaneous gas. After the eruption in 1959, the content of CO_2 was 28-46,9 %, after the eruption in 1979 – 25,87 %, and according to our data the content of CO_2 was over 70 % with a maximum of 94,6 %. The content of CH_4 was, respectively, 28-46,9 % (1959) and 54,44 % (1979), but in our results, it was less than 32 %. The possible reason for this is that the last eruption of South Sakhalin Mud Volcano was in 1996, and then, during the passive state of the volcano (1996-2001), the ratio of CO_2 and CH_4 has changed probably because of biogeochemical processes.

The monitoring of South Sakhalin Mud Volcano was held from 12th till 23rd of July, 2001. During the observation, an increase in the flow rate of spontaneous gas, the temperature of mudvolcanic waters and the variation of some geochemical values were revealed. On July 23, 2001, an earthquake with a 3 point magnitude was indicated in Sinegorsk, e.g. in a distance of several kilometers from the volcano. The variation in the

geochemical parameters given above was apparently caused by the intensification of tectonic stress in Earth's crust before the earthquake.

The gas of Daginsky Mud Volcano had the following components: CH_4 – 91,8 %, CO_2– 0,5 %, N_2 – 7,3 %, O_2 – 0,3 %. These results correspond to the data received during the Russian-German Kurile-Okhotsk Sea Marine Experiment (KOMEX) as follows: abnormal concentrations of methane from 563 nl/l in upper levels to 5510 nl/l in ground level (June 2000, station GOO-2) were indicated in the water mass of the northeastern Sakhalin shelf. These data allow to suppose that methane vents analogous to Daginsky Mud Volcano expand widely throughout the northeastern Sakhalin shelf.

MOOSE AND TALL SHRUBS: NEW EVIDENCE ON THE EARLY HOLOCENE CLIMATIC OPTIMUM IN THE LENA DELTA

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The northern advance of tall shrubs during the Early Holocene climatic optimum (ca 9.5-8 ka) is a well known phenomenon in the East Siberian Arctic. Fossil wood of alder and birch shrubs, and tall willow are frequently found in the areas, currently occupied by tundra, often together with larch and tree birch (Kuznetsova et al., 1999). For instance, between 10 and 9 ka, shrub alder reached Bol'shoy Lyakhovsky Island (Kremenetsky et al., 1996). However, the general environment of that period, and mammal fauna especially, remains poorly known. A recent discovery of a fossil moose carcass on Bykovsky Peninsula may contribute to this knowledge.

The well-preserved carcass of a large animal was first found in the SE extension of the famous Mamontovy Khayata (MKh) cliff by local people a few years ago, but the find remained essentially unnoticed by scientists, probably because it was thought that it belonged to a modern domestic horse. In August 2001, the carcass was re-found by A. Ivantsov and Ya. Malakhovskaya from the Paleontological Institute RAS, who officially informed the Lena Delta Reserve about their discovery. Soon after that, a research team from the Reserve searched the site and made the first inspection of the carcass. A few days later, they came back to collect the find, this time having invited the Quaternary paleontology experts from the Severtsov Institute, who at that time worked at the main MKh section.

The carcass turned out to belong to a young female of moose, *Alces alces* (about 1.5 years old). Most of the body was still preserved: partially articulated extremities, vertebral column and skull, muscle, ligament and other tissue, intestines, skin with hair, etc. All that, scattered over the spot of 2-3 m, had a strong putrid smell and was covered by active mass of necrophilous insect larva. The whole carcass, especially the condition of the soft tissues, gave the impression of a recently dead animal. Although moose do not live in arctic tundra, their rather long summer excursions to the Lena Delta were documented, so the first most likely assumption was that it was modern. Nevertheless, a large part of the carcass with all kinds of tissue was collected and transported to a storage in the Lena Delta Reserve in Tiksi.

The carcass was found in the lower third of the Ice Complex cliff, in about 25 m from the top, on a gentle slope below the main ice wedges exposure and baydzherakhs, and above the thermo-terrace, rather narrow at this place. The area of the site was covered by flat accumulations of mud, with numerous plant hummocks on the top of it, which most likely slid down from the very top of the cliff. A marking feature of the site was the abundance of wood sticks, scattered around on the mud surface; some of them were complete stems of large shrub plants up to 2 m high (one of those lay directly besides the carcass and was collected). Nothing of that kind currently grows on Bykovsky Peninsula, so the wood was definitely fossil. A thin layer of the Holocene sediment with numerous wood remains on the top of the Ice Complex was earlier observed by the senior author in this part of the MKh area. Many samples of plant organic, overlying Ice Complex, were ^{14}C dated between 7,000 and 9,000 years ago, so a well-reasoned assumption was that the large shrub remains come from the time of the Early Holocene climatic optimum.

Radiocarbon dating of a skin sample with hair (taken by A. Ivantsov) in the Geological Institute showed the date of 8080+\-120 years (GIN-11727). That means that the moose definitely lived during the Early Holocene climatic optimum, and the carcass comes from the sediment, rich with shrub remains, overlying the Ice Complex.

The collected tall shrub specimen (pending identification) most likely belongs to willow (*Salix* sp.) or shrub alder (*Alnaster fruticosa*). At present, shrubs up to 2 m height are observed in river valleys a few dozen kilometers north from the forest limit. In the Lena valley they reach their northernmost limit at about 72°N, which is farther north by latitude than the fossil locality. However, no tall shrubs grow in small valleys east of the Kharaulakh Mountains in the Tiksi area.

The northern limit of moose range generally corresponds to the sparse forest limit, but visiting tundra zone along river valleys with rich willow shrubs during summer is quite common for moose (Labutin et al., 1985). Less frequently, individual animals make more distant excursions to the north (beyond the tall shrub limit): three occurrences of that kind have been documented in the southern part of the Lena Delta and south of Tiksi during the last 10 years.

Thus, the discovery of a fossil moose carcass on Bykovsky Peninsula does not extend its past distribution much farther north against the modern. But in combination with the past abundance of tall shrubs, it definitely indicates a quite different vegetation and environment at the site in the Early Holocene. The further study of this find (including the stomach contents) will contribute to a better understanding of the peculiar environment in the Holocene climatic optimum. The fossil carcass of the moose is also a unique object for morphological, genetic and other studies of these animals. This study was partially supported by RFBR (projects 01-04-48921, 01-04-48930).

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PLEISTOCENE CLIMATE DRIVERS OF THE EAST SIBERIAN SHELF LAND

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Many special features of past environment and biota of the East-Siberian Arctic Shelf Land (ESASL), which included the currently inundated shallow shelf and modern coastal lowlands, were driven by its peculiar climate. The climate, in its turn, was controlled by a few main drivers.

The first one was the geographic position of the shelf land in the high latitudes, distant from the heat-transferring systems of the Atlantic and Pacific, and isolated by a huge continent and the Arctic Ocean. Initially, for that reason ESASL was one of the first areas in the Northern Hemisphere, seriously affected by the Late Cenozoic global cooling of the earth. As a result, stable permafrost appeared here as early as in the Pliocene, 2.5-3 million years ago or even earlier, and many organisms potentially had the longest time span to evolve cold-resistance and corresponding adaptations.

The second major climate driver was the position of the Arctic Ocean shoreline. The geological evidence available indicates a very restricted distribution of Plio-Pleistocene marine sediments within the ESASL. They are currently exposed on the Anjou Islands only, north of 74°N (represented by shallow lagoon facies) and in some boreholes on the shelf. The age of these sediments is far from being certain, as they include numerous redeposited Miocene microfossils. As compared with the areas to the west and to the east, the shelf of the Laptev and East-Siberian seas existed probably for most of the Pleistocene

in a terrestrial mode. The main consequence of that was that the ESASL climate was permanently marked by a high continentality.

The global climatic changes were the third climate driver. Being strongly overridden by the first two factors, the global changes had a limited manifestation in the ESASL. Only major trends and events, such as the general Late Cenozoic climate cooling, or the Pleistocene/Holocene environmental collapse, can be easily recognized here, while the fluctuations, revealed in the oceans and documented as marine isotope stages (MIS), may be recorded in the ESASL in a much less evident or distorted way.

The permanent effect of the first driver – the geographic position – is clear and does not need any comments. The role of the other two drivers – dominantly terrestrial mode and global fluctuations – can be illustrated by the results of the recent Russian-German work in the Laptev Sea area.

The composite section on the south coast of Bolshoy Lyakhovsky Island covers a large time span, the scope of which is still controversial and ranges from 1,000,000 to 200,000 years . Of four units recognized, one, provisionally labeled as "Krest-Yuruakh" (horizon of large ice-wedge casts below the Ice Complex), was probably deposited during the "warmest" climatic interval. The "shorter" version of the section age (Schirrmeister et al., 2002) directly suggests the Eemian age for this unit. However, those scientists who do not accept the 200 ka U/Th date for the reversely magnetized lowermost unit and hold the "longer" interpretation of the section, also do not exclude the possibility of the Eemian age equivalent for the "Krest-Yuruakh". Insect fauna and plant macrofossils of this unit indicate the "warmest" climate interval. The abundance of large shrub remains (alder), the presence of insects, typical for southern shrub tundra and forest-tundra, show a much richer vegetation of that time than the present one. On the other hand, the share of xerophilous insects in the "Krest-Yuruakh" assemblages, and steppe species in particular, is the highest throughout the section (Kuzmina, 2001). That means that the unit was formed under an extremely continental climate, with the summer temperature much higher than today, but the shoreline at that time was quite far from the site. Thus, if we accept the correlation of "Krest-Yuruakh" with the MIS 5, the paleoecological evidence for that time is quite different from the traditional concept of the Kazantsevian time in the Siberian Arctic (warmer and milder climate and marine transgression). A similar situation is shown by the detailed record of the "Karginian" stage in the Lena Delta (Bykovsky Peninsula). During the whole time span of 50 to 25 ka (corresponding to the MIS 3) the climate was extremely dry and continental. Contrary to the traditional model of the Karginian, with three intervals of warmer and wetter climate, this record indicates the climate with warm summers in the first half of this time interval, and very cold summers in the second half (Sher et al., 2001). Winters were extremely cold throughout the Karginian, and the whole record does not allow deducing a close vicinity of the shoreline.

On the other hand, we believe that the Bykovsky sequence for the first time shows the response of arctic terrestrial biota to the Last Glacial Maximum. According to the paleoecological evidence, the climate of the corresponding interval was quite dry, but marked by lower summer temperature and possible reduction of the numbers of herbivorous ungulates.

Thus, it seems that the ESASL climates were first of all driven by the effect of a vast land massive (remote position of the shoreline). Under the impact of the high continentality and northern position of that land, the global temperature fluctuations probably somehow affected summer temperature only.

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PATHWAYS AND FLUXES OF NATURAL AND ANTHROPOGENIC TRACERS IN THE LAPTEV SEA AND ADJACENT ARCTIC OCEAN

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Traditionally riverine input was assumed to be the main geochemical pathway of terrestrially and anthropogenically derived compounds from their sources to the marine environment, but there is much evidence that atmospheric input contributes significantly to the input into marine areas.

In this work results of studies of aerosol and suspended matter, collected during the ARK-XI/I expedition of RV "Polarstern" (July-September 1995), aerosols and suspended matter collected in 17-th expedition of RV “Akademik Fedorov”, snow and ice-rafted sediments from the northern Laptev Sea and adjacent Arctic Ocean (expedition ARK-XIV/la of RV "Polarstern") are presented.

It has been shown that the concentrations of most chemical elements in aerosols are nearly of the same order as those of literature data from other Arctic areas. A catastrophic increase of element content due to the anthropogenic factor in the summer-fall was not found. The high value of C/N ration in particulate matter in the Central Arctic (in average 17.2) testifies that terrigenic organic matter dominates. The atmospheric input of matter in the central part of the Arctic Ocean is an important pathway of delivery of many natural and anthropogenic substances.

Our studies were financially supported by the German and Russian Ministries for Science and Technology within the framework of the Otto Schmidt Laboratory fellowship and “Laptev Sea 2000” project.

STUDY OF GAS HYDRATE ACCUMULATIONS ASSOCIATED WITH FLUID DISCHARGE AREAS: SOME SUGGESTIONS TO THE RUSSIAN-GERMAN COLLABORATION

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There is reason to believe that the present investigations of gas hydrate accumulations related to fluid discharge on the seafloor are of fundamental importance for studying natural gas hydrates. All known submarine gas hydrate occurrences located near the seafloor, both on active and passive continental margins, are associated with gas-containing fluid discharge. It can consist of mud volcano fluid, water with dissolved gas or of ascending flow of free gas. The list of such occurrences includes 14 regions of all 22 sites where submarine gas hydrates have been observed.

Since pressure and temperature are the most important conditions determining the overcooling and oversaturation of the fluid in sediments directly near the seafloor, fluid discharge areas can be considered as peculiar natural reactors where gas dissolved in water or free gas stabilizes as a hydrate forming modern gas hydrate accumulations. In deep water (outside shelf areas), the discharge of gas-containing fluids on the seafloor is widespread. More than 70 regions with evidences of deep water fluid discharge are currently known in the Ocean. All of them can be considered as potentially gas hydrate-bearing.

Based on the available world data analysis and data of special experimental and field (in cruises) investigations, our suggestions to the Russian-German collaboration are the following:

1. to reveal principles of distribution of gas hydrate accumulations associated with fluid discharge areas and estimate the possible amount of such accumulations in the Ocean;

2. to provide geological-geochemical features and the origin of hydrate-forming fluids in different fluid discharge areas;

3. to construct geological-geochemical models of gas hydrate accumulations related to fluid discharge areas both on active and passive continental margins;

4. to analyze available data on filtration velocity of gas-containing fluids and estimate parameters of gas diffusion in pore medium under presence or absence of gas hydrate phases;

5. to determine the possible range of the volumetric rate of gas hydrate accumulation in the spectrum of parameters such as water and gas composition, gas solubility, pore size, overcooling (oversaturation) value, thermo-physical properties of medium and filtering fluid volume.

The importance of gas hydrate at the seafloor as a fuel mineral as well as in relation to a possible global climate change will be explained as a result of this work.

DIAPYCNAL ENTRAINMENT OF SHELF WATERS INTO INTERMEDIATE DEPTHS ACROSS THE SAKHALIN CONTINENTAL SLOPE (SEA OF OKHOTSK)

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The northern shelf is the main source area of dense water for the formation of the Sea of Okhotsk Intermediate Water. It is generally accepted that shelf waters can ventilate the deep sea down to 1000m depth. During winter time, shelf waters have in general a density of 26.7-26.9 σ_θ with a temperature close to the freezing point. But such density values are much lower than those at intermediate depths and not sufficient for ventilating the deep sea by isopycnal transport. Numerous attempts to find shelf waters as dense as Kitani Water have failed. In this presentation, an explanation is given supporting the idea that shelf waters diapycnally penetrate into deep layers with a higher density of surrounding waters.

The results of seasonal CTD observations during KOMEX demonstrate an appearance of intrusions of cold waters with a negative temperature at intermediate depths and on the bottom of the slope during cold seasons. At this time, the density of shelf waters becomes higher than at corresponding depths offshore. The situation on the shelf break becomes unstable and convenient for diapycnal entrainment of shelf waters across the slope. The main reason for the sinking is the gravitational flow on the sloping plane. Calculations demonstrate that shelf waters with a density of 26.84 σ_θ can diapycnally penetrate up to 600 m depths. The main energy source for this process is the potential energy which shelf waters get during winter time. The cabbeling effect is an additional source of energy for diapycnal mixing across the slope. The ventilation of intermediate water is strongly influenced by seasonal variations of atmospheric forcing.

OCCURENCE OF NITRIFYING BACTERIA IN PERMAFROST SOILS

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Nitrifying bacteria play a main role in the global nitrogen cycle. Two groups of lithoautotrophic organisms – the ammonia and the nitrite oxidizers – are responsible for the oxidation of ammonia to nitrite and nitrite to nitrate. Nitrifiers are ubiquitous and occur even in extreme habitats because they can survive long periods of starvation and dryness. An examination of the distribution of nitrifying bacteria in vertical profiles of permafrost sediments of the Kolyma Lowland demonstrated that the number of samples containing nitrifiers decreased with increasing age of the deposits. These highly specialized organisms were able to preserve their viability up to 3 mio years at a depth of 60 m [reviewed by 1]. Whereas nitrifiers from upper layers (up to 40.000 a) grew best at 28°C, in more ancient sediments (0.6-2.5 mio a) their potential activity was highest at 17°C. Identified by their

characteristic morphology and ultrastructure, the ammonia oxidizing isolates belong to the *Nitrosospira* cluster and enriched nitrite oxidizers to the genera *Nitrobacter* and *Nitrospira*. These organisms originated from 40,000-year-old deposits. The substrate ammonia was measured in concentrations up to 3 µmol/g wet soil material in all geological horizons of the vertical profile up to an age of 3 million years. The products of nitrification – nitrite and nitrate – were found in sediments up to 1.8 million years. Nitrite and nitrate were measured in concentrations up to 0.5 and 2.9 µmol/g wet soil material, respectively.

The key question regarding viable paleobacteria in permafrost is whether they are active in the frozen environment or if they are in a dormant state. The presence of the chemically instable nitrite gave first evidence of modern microbial activity in permanently frozen sediments. Nitrifying bacteria may be suitable as indicator organisms for the reconstruction of climate conditions in the past by the preservation of physiological adaptation. Today, their influence on the global climate by the generation of the trace gases NO and N_2O is part of actual research topics. In permafrost soils, NO production could be measured up to a depth of 60 m.

Referenzen

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HISTORY OF EURASIAN ICE SHEETS REFLECTED IN ARCTIC DEEP-SEA SEDIMENTS

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The Eurasian ice sheet history is documented in Arctic deep-sea sediments by the content of iceberg-rafted terrestrial debris (IRD) and the isotopic signature of planktic foraminifers which truthfully records salinity changes from meltwater input. Refinement of the stratigraphic models for long sediment cores along a transect from the Fram Strait to the Alpha Ridge now allows to determine and correlate regional and basin-wide events. The cores were obtained far enough from the glaciated shelves to exclude local influences of small ice sheets. IRD input indicates the arrival of ice sheets at the shelf break and their decay on the northern Eurasian shelves during periods of sea-level rise. Low oxygen isotope ratios reflect low-salinity events which may have been caused by the input of meltwater from decaying ice sheets on the shelf or the release of freshwater previously trapped in lakes, which were barred by ice at their northern exits. Furthermore, the abundance records of planktic foraminifers reveal repeated phases of open water in the Eastern Arctic Ocean during times of ice sheet build-up.

According to new reconstructions of the terrestrial glacial history in Northern Eurasia, ice sheets extended far to the east and must have blocked (repeatedly?) the northward flowing rivers between Scandinavia and the Taymyr Pensinsula during the cold phases of oxygen isotope (sub)stages 5b and 4 (ca. 90 and 60 ka, respectively), but probably not during the last glacial maximum (LGM, ca. 20 ka). The progression of the ice sheets onto the shelves is reflected in the deep-sea sediments by elevated IRD contents. Often, such phases were accompanied or preceded by periods of repeated occurrence of open waters which probably acted as a moisture source for the ice sheets. Maximum IRD contents in the sediments reflect deglaciation phases and are especially high at the end of oxygen isotope (sub) stages 6, 5b, 5a, and 4, as well as during early stage 3. In most sediment cores from the central Arctic, no IRD peak can be found in LGM sediments. The pronounced low-oxygen isotope values of rare planktic foraminifers from the deglacial events in (sub)stages 6, 5b, 5a, 4, and 3 indicate the release of meltwater from lakes in northern Russia and NW Siberia. These data strongly support the results of the terrestrial working groups within the QUEEN program for the Weichselian period and allow similar reconstructions also for the preceding Saalian glacial.

OSTRACODA OF THE LAPTEV SEA: HOLOCENE TO RECENT

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Ostracoda are an important group of calcareous fossils that are well preserved and abundant in sediments of different genesis, from aquatic terrestrial to deep-sea marine. Their well-defined ecological affinities, especially salinity dependence, makes them well-suited for paleoenvironmental reconstructions in the Laptev Sea. The ostracod fauna recorded in the Laptev Sea is rich in taxa, a total of 45 species belonging to 21 genera, 12 families were identified. We distinguish three ecological groups of ostracod species: 1) brackish-water, 2) euryhaline and 3) normal marine ones.

Sorting these groups together with water-depth relationships allowed for an establishing of four assemblages that cover the Laptev Sea shelf and the upper continental slope. The taxonomically diverse and abundant assemblages of the western and central Laptev Sea seems related to Atlantic waters and occupy the upper continental slope. These include relatively deep-living species that show clear affinities to the North Atlantic and Arctic Ocean (*Cytheropteron biconvexa, C. testudo, C. simplex, C. nodosoalatum, C. inflatum, C. porterae, Krithe glacialis, K. minima, Pseudocythere caudata, Polycope punctata, P. orbicularis*). In the eastern shelf region affected by river runoff two assemblages were recognized. The central part (31-51 water depth) is occupied by the *Acanthocythereis dunelmensis* assemblage that includes normal marine species (*Semicytherura complanata, Elofsonella concinna, Cluthia cluthae*). The inner shelf assemblage of the southern Laptev Sea (21-31 m water depth) is dominated by shallow-water euryhaline species (*Paracyprideis pseudopunctillata* and *Heterocyprideis sorbyana)* with admixture of the brackish-water species *Roundstonia macchesneyi*.

The composition of fossil ostracodal assemblages in Holocene sediments from the eastern Laptev Sea shelf shows a gradual increase in species diversity with time. At the initial stage of inundation (11.3-10.8 cal. ka), an extremely taxonomically poor assemblage of brackish-water (*Roundstonia macchesneyi, R. globulifera, Loxoconcha venepidermoidea*) and euryhaline *(H. sorbyana, P. pseudopunctillata*) species inhabited the Lena and Yana paleovalleys at the present water depths of 50-55 m. It was replaced by a transitional assemblage (10.8-8.2 cal. ka) in which euryhaline species co-existed with normal marine species. The sharp change in species composition occurred 8.2 cal. ka, when numerous normal marine species appeared on the middle shelf. All euryhaline and brackish-water species, except *P. pseudopunctillata,* disappeared at this time. Ostracodal assemblages from the inner shelf region show less obvious changes in species composition – from a relatively taxonomically poor assemblage dominated by *P. pseudopunctillata* with some normal marine species (ca. 5.6-2.7 cal. ka) to diverse assemblage with abundant brackish-water and euryhaline species since 2.7 cal. ka (*R. macchesneyi, R. globulifera, H. sorbyana*). This marked change probably reflects the increasing influence of river runoff at the studied site during more recent times.

HOLOCENE ENVIRONMENTAL CHANGES OF THE EASTERN LAPTEV SEA: EVIDENCE FROM FOSSIL ASSEMBLAGES

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Temporal and spatial variations in the species composition of recent and Holocene assemblages of molluscs, ostracods and foraminifers from the Laptev Sea shelf were investigated to reconstruct paleoenvironmental changes during the times of postglacial sea-level rise. For this purpose, four AMS^{14}C-dated sediment cores, recovered during the TRANSDRIFT V expedition from the Lena (45, 32 and 21 m water depth) and Yana (51 m water depth) paleovalleys, were used.

In the cores from the middle shelf, three fossil assemblages were established that reflect the gradual replacement of 1) taxonomically poor pioneer assemblages of the initial stages of inundation (with the euryhaline and brackish-water species *Portlandia arctica cf.*

aestuariorum, Cyrtodaria kurriana, Heterocyprideis sorbyana, Loxoconcha venepidermoidea, Roundstonia macchesneyi, Elphidium incertum, E. clavatum) by 2) transitional assemblages (co-occurrence of euryhaline and normal marine species) and, finally, 3) taxonomically diverse assemblages dominated by normal marine species similar to the modern benthic communities of the studied area (*Leionucula bellotii, Macoma calcarea, Acanthocythereis dunelmensis, Palmenella limicola, Semicytherura complanata*, different elphidiums). Changes in composition of molluscan and ostracodal assemblages appeared to be simultaneous and well pronounced, while foraminifers exhibit only minor variations in their species diversity, and then, only during the early stage of inundation.

Based on the downcore succession of fossil assemblages of molluscs and ostracods along with other sedimentological data, three phases of paleoenvironmental changes were recognized: (1) ca. 11.3 - 11.1 cal. ka in the Yana paleovalley and ca. 11.2 - 10.8 cal. ka in the Lena paleovalley - nearshore brackish-water environment with depths less than 10 m, reduced (20 and less) and seasonally variable bottom salinity, high sedimentation rates (up to 500 cm/kyr in the Yana valley) and active input of terrestrial plant debris due to shelf-coastal erosion and fluvial runoff; (2) ca. 11.1 – 8.2 cal. ka (Yana paleovalley) and ca. 10.8 - 8.2 cal. ka (Lena paleovalley) – shallow-water environment affected by fluvial runoff, water depths around 20 m, average bottom salinity around 26-28, decreasing, but still high (about 100 cm/kyr) sedimentation rates indicate close location to the main river depocenters; (3) - since ca. 8.2 cal. ka in both valleys sharply increasing taxonomic diversity marks the transition to the onset of the present marine environment with a bottom salinity around 30-32, low sedimentation rates (about 20 cm/kyr) and strong bottom currents (very low sedimentation rates in the Yana paleovalley since ca. 5 cal.ka).

In the cores from the inner shelf, dating back to ca. 8.4 and 6.4 cal. ka, changes in fossil assemblages are less obvious. In general, species diversity increases upcore, but no analogs of the taxonomically poor pioneer assemblages of the initial stages of flooding were found. The most evident change from taxonomically poor assemblages with *P. arctica, P. pseudopunctillata* and few *Elphidiidae* species to a diverse assemblage with abundant brackish-water and euryhaline ostracods (*H. sorbyana, R. macchesneyi, R. globulifera*) occurred about 2.7 cal. ka which marked the transition to more river runoff affected environment. In the core from 32 m water depth, the time interval of ca. 2.7-1.3 cal. ka is characterized by the presence of vivianite, a mineral originating from lakes and probably transported to the shelf with riverine water. Also, the observed increase in sedimentation rates in both cores after ca. 1.5-1.3 cal.ka could have been initiated by increasing freshwater discharge.

HOLOCENE CLIMATE AND ENVIRONMENTAL CHANGES IN THE GREAT STEPPE OF EURASIA

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Lake sediments are one of the best terrestrial archives storing information on past changes in climate and environment. Among the various proxies, pollen data can be succesfully used for a quantitative vegetation and climate reconstruction. The great steppe of northern Eurasia extends from the Ukraine throughout the vast areas of southern Russia, Kazakhstan and Mongolia to China in the east. In the vegetation modelling, the steppe biome can be defined by the very simple combination of the bioclimatic limits (Prentice et al., 1992). These are the moisture index defined as the ratio of actual to potential evapotranspiration (0.2-0.65) and the annual sum of mean daily temperatures above 5°C (>500°C-day). Thus, both lake level and paleovegetation records from the steppe zone should be very sensitive to changes in moisture availability. In the present study, we selected three pollen records from the transitional forest-steppe zone of northern Eurasia in order to reconstruct changes in the moisture balance in the eastern, central and western parts of the steppe zone since the late Glacial. These results are presented together with the lake-status and plant macrofossil records from this region (Tarasov et al., 1996; 1999; Gunin et al., 1999). The pollen-based climate reconstruction performed with the best modern analogue method (Guiot, 1990) shows different patterns of changes in precipitation and

moisture index in Mongolia, Kazakhstan and the Ukraine, suggesting that the different circulation mechanisms should be involved to explain the reconstructed changes.

POLLEN IN SHELF SEDIMENTS AS INDICATOR OF CLIMATE CHANGE IN ARCTIC SIBERIA

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Since August of last year we have been carrying out our research project supported by the Otto Schmidt Laboratory. It is devoted to climatostratigraphic reconstructions of the Laptev Sea areas under the conditions of post-glacial air temperature increases and sea level rise through absolute pollen analysis of marine sediments with morphological investigation of pollen indicators using scanning electron microscopy.

It is known that plants represent a stable and reliable proxy for changing temperature and humidity. One of the best features that indicates the climatic fluctuations in the Arctic is the north-south shift of the northern forest edge. Such a shift may be established by pollen analysis. As first studies have shown, pollen records from near-coastal marine sediments can give reliable information of climate-related vegetational changes on land.

The material used in our study was collected during the TRANSDRIFT expeditions aboard "Professor Multanovsky", "Kimberlit" and the research icebreaker "Polarstern". Sampling of the "Kimberlit" holes was carried out by the students together with Russian and German colleagues in St. Petersburg. The processing of samples for pollen analysis was performed by the students at the laboratory of the Alfred Wegener Institute for Polar and Marine Research, Potsdam. All marine samples were freeze-dried and then treated to dissolved carbonates, silicates, organic soil colloides and celluloses according to the international standard method, including acetolysis.

Absolute pollen analysis of core samples – identification and counting of pollen grains using light microscope - was carried out by O. Naidina. Preliminary zones were identified in each pollen diagram of the investigated cores. Thus, from alternating *Betula* and *Pinus* grains values in the cores K1005(1-1) and K1005 (1-2) the pollen diagrams can be divided into two cooling and two warming events.

One of the problems for pollen analysis is the identification of fossil pollen to species. Scanning electron microscopic (SEM) identification of fossil conifera pollen to species was carried out at the Biological Faculty of Moscow University. All SEM investigations including pollen extraction and techniques were performed by the students according to the method of N. Meyer-Melikian. For a comparison with fossil pollen there were used pollen grains of living plants from the Herbarium of the Biological Faculty and from a soil sample collected in *Pinus pumila* shrubs tundra in West Kamchatka during the Geological Expedition of the Institute of the Lithosphere of Marginal Seas in 2001. In accordance with the SEM analysis we believe that the main component of haploxylon-type pollen from the Laptev Sea cores PM9499, PS51-135 and K1005 belongs to the shrubby pine *Pinus pumila* from the Verkhoyansk highlands. These coniferae species are sensitive indicators of the environment. These results are very important for the climatostratigraphical interpretation and for the reconstruction of sources of pollen grains and possible ways of their transportation in the Laptev Sea.

DISCOVERY OF LISTERIA MONOCYTOGENES IN THE NORTHWEST OF THE OKHOTSK SEA

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Research material was obtained during the following expeditions: Ice-99, Ge-99 and G00-28. 222 sea water samples, 7 ice samples and 17 sediment core samples were tested. From these samples, 16 L. monocytogenes strains were isolated: 8 from sea water, 6 from ice and 2 from the sediment.

The analysis of the results showed that the presence of Listeria in the surface waters of the northeastern Sakhalin shelf and slope was a result of the Amur River outflow. Thus, the maximum bacteria strain quantity was isolated from the surface waters in autumn (September 1999). This corresponds to the annual maximum of the Amur River outflow in late summer and early fall. The L.monocytogenes disposition in the ice cores confirms this conclusion, too. Thus, in the Sakhalin shelf ice (St. Ice-3), which is influenced by fresh river water, L.monocytogenes were discovered in the surface water and throughout the ice core save for a thin layer. In the slope area (Ice-2), where the ice cover is thicker, the studied bacteria were found in the lower part of the core. In the ice samples selected at station Ice-1, Listeria were not discovered. In winter time, L. monocytogenes were found closer to the Sakhalin coast than in summer. This is explained by the fact that the fresh waters are closer to Sakhalin Island in March due to the annual minimum of the Amur River flow in winter. All L.monocytogenes strains were found exclusively in the area of submarine gas venting, mainly methane. Evidently, it can be explained by the Listeria adjustment to gas- and methyltrophy (Bouzoleva et al., 2000). Besides, Listeria were discovered in methane hydrate-containing sediment (Obzhirov Flare) at two stations: St. Ge-24 at 2,6 m depth and at St. Ge-16 in the upper layer of the sediment and the bottom water.

The obtained results show that the Amur River flow and the low-temperature sea water regime with their abnormal concentration of methane are abiotical sea water factors that create favourable conditions for the existence of Listeria bacteria at the northeastern shelf and Sakhalin slope. This corresponds to the data of Watkins and Sleath (1981), Schwartzbrod et al. (1989), as well as Grimes (1991) which display that the sea water infection by L.monocytogenes is conditioned by the river`s water and material input.

TEN YEARS OF RUSSIAN-GERMAN COOPERATION IN GEOSCIENCES

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Mankind has an increasing interest in establishing forecasts within whose ranges its own living conditions may change in the foreseeable future. Geological synoptic reconstructions and climate modelling have shown independently that the polar latitudes of the northern hemisphere, in particular its marginal seas and adjacent continents, are apt to drastic and fast changes. Most of these important investigation areas belong to the Russian Federation today.

Since October 1987, when Soviet Union president Mikhail Gorbachev called on the world community to ensure peaceful co-existence in the Arctic, international cooperation of research and rational utilization of natural resources and conservation of the environment, Russian and German scientists have got the possibility to investigate these extreme environments. In the same year, the first research vessel since Nansen's "Fram", Germany's RV "Polarstern" penetrated deep into the Eurasian Basin of the Arctic Ocean, dedicating part of its research time to studies of the sea ice which originated from the vast Siberian shelves.

In the early 1990s the German Ministry for Education and Research and the Russian Minstry of Industry, Sciences and Technologies decided to fund major comprehensive

research programs which were combining the efforts of highly qualified Russian and German scientists. These projects addressed both oceanic and terrestrial processes, and their consequences for marine terrestrial biota, landscape evolution as well as land-ocean interactions. The primary scientific goal of these multidisciplinary programs is to decipher past climate variations and their impact on contemporary environmental changes.

Extensive studies on the atmosphere, sea ice, water column, and seafloor on the Laptev Sea Shelf, as well as vegetation, soil development, carbon cycle, permafrost behavior and lake hydrology, and sedimentation on Taymyr Peninsula und Severnaya Zemlya Archipelago have been performed since 1991 within the framework of the projects Laptev-Sea System, Laptev-Sea System 2000, Late Quaternary Environmental Evolution of Central Taymyr and Ecology of the Marginal Seas of the Eurasian Arctic.

Since 1997, Russian and German scientists have also been also studying the history and environmental impact of river run-off to the Kara Sea within the SIRRO project. The area is of particular interest because of its importance for water mass transformation in the Arctic Ocean and its influence on the global thermohaline circulation.

In addition to the Russian–German joint efforts in studying the Russian Arctic, another bilateral project entitled KOMEX (Kurile Okhotsk Sea Marine Experiment) was founded in 1998 to study the tectonics, environment and ecology of the climate forcing and ecologically highly sensitive system of the Sea of Okhotsk and the Kurile-Kamchatka-Island Arc System.

In fall 1999 the Otto Schmidt Laboratory for Polar and Marine Research (OSL) a milestone in Russian-German cooperation was founded in St. Petersburg. The OSL, named after the Russian polar researcher Otto Yulievich Schmidt (1891-1956), provides the basis for coordination and further development of research projects carried out within the framework of the Bilateral Agreement on Cooperation in Polar and Marine Research between the Russian Federation and the Federal Republic of Germany. The main task is to further the qualification and support of young scientists. Education is also the main aim of the new master program POMOR, a joint project of Saint Petersburg State University, AWI, GEOMAR, Bremen University and five other universities of northern Germany. Starting in October 2002 Russian students will begin master classes in applied polar and marine sciences.

HOLOCENE MULTIDECADAL TO CENTENNIAL CLIMATE VARIABILITY IN THE SEA OF OKHOTSK

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Today, a major challenge for paleoclimate research consists in understanding the nature and principle processes of multidecadal climatic cyclicities and rapid climatic changes. However, for one of the world ocean's largest basins, the subarctic NW-Pacific, investigations so far have been hampered by an absence of Holocene high-resolution marine records.

Our recent work in the Sea of Okhotsk reveals a record of multidecadal cyclic climatic changes in this NW-Pacific marginal basin and the adjacent Amur River drainage basin. Within this area the humid SE-Asia monsoon regime in summer is contrasted by cold, dry continental climate from NE-Siberia in wintertime. These two patterns show considerable variability in both strength and lateral extent on multifaceted timescales. Thus this region is crucial for our comprehension of complex changes and shifts of atmospheric and oceanographic systems in the subarctic Far East and western North Pacific region.

We recovered gravity core LV28-4-4 from 674 m water depth off the continental margin of NE–Sakhalin where high biogenic productivity and terrigenous sediment supply by the Amur River drainage system are main contributors to the depositional environment. Our present age model consists of 16 AMS radiocarbon control points from planktic foraminifera and benthic shell fragments fit by three ninth order polynomial regressions. According to this, maximum sedimentation rates exceed 120cm/kyr during the last 8000 years, decreasing down to 20 cm/kyr in the older parts of the core. Thus to date our investigations reach an average temporal resolution of 20-50 years between discrete sample points for the Holocene.

Based upon a multiproxy approach, we use content and accumulation rates of opal as a proxy for primary biogenic productivity, while trace element distribution and amount of terrigenous fraction serve as an indicator for riverine sediment supply. Whereas these datasets provide high-resolution records, stable isotope data of benthic and planktic foraminifera supplement our results on a lower temporal scale. Our results show high-frequency oscillations in Amur River discharge and biogenic productivity that can be correlated to the oxygen isotope record of the Greenland GISP II ice core record. Beneath major incidents like Younger Dryas or Terminations Ib and Ic, we also feel confident to recognize significant short-term events like the Medieval Warm Period or the Little Ice Age. First spectral analyses reveal several centennial periodicities with a maximum power of a 940-years peak in the Holocene interval of 8500–4000 years. In the youngest interval of 0–4000 years, though, a transition towards a 1200-year cyclicity appears, hitherto unexplained.

Future research will be focused as a first on additional marine sites to depict more closely the Amur's runoff variability and its impact on Sea of Okhotsk oceanography, and besides on possible linkages to other high-resolution archives from diverse SE-Asia monsoon locations.

CLIMATE SCALE VARIABILITY OF THE ARCTIC ATMOSPHERE AND OCEAN CIRCULATION AND ITS LINK WITH THE ARCTIC SEAS

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Within the last decades the significant changes have occured in the arctic climate system. The phenomenon of relatively rapid warming in the Arctic observed within the 20th century affected all elements of the arctic climatic system. A decrease of glacier mass is observed, transformation of permafrost occurs, coastal erosion processes increase, and the influx of tundra origin methane to the atmosphere increases as well.

The extreme intensification of the cyclonic component and air temperature increase have been accompanied by the decrease of area and thickness of the arctic ice and an abnormal temperature increase of the Atlantic Waters within the 1980s and 1990s. These intensive anomalies of processes forming the climate (atmospheric, ice and oceanic) set the task to estimate more completely and accurately the state of the climatic system and the arctic environment and to forecast it as well.

The report presents the main characteristics of current changes in the arctic climate caused by changes in the regime of the Arctic seas. Indices of atmospheric circulation, air temperature in the Arctic, circulation of surface waters in the Arctic Ocean, sea level, freshwater balance, ice cover of Arctic seas and inflow of fresh water from the continent into the Arctic seas are analyzed.

For the 20th century the stages of warming and cooling and the changes in the Arctic Ocean state connected with these stages have been revealed. So, the specific circulation regimes of atmosphere and ocean correspond to the regimes of inflow of fresh water, thermohaline structure and ice cover of the Arctic seas.

Available data allow us to define the trends and cyclic recurrence of the main climatic characteristics changing. Cyclic climate oscillations with a duration of 50-60 years are typical for the Arctic. These oscillations have an influence on the indices of the atmospheric circulation, air temperature, ocean surface circulation, and freshwater balance and ice conditions in the Arctic seas. All known climatic phenomena of the 20th century observed in high latitudes (warming in the Arctic within the 1920s-40s, cooling within the 1960s-

70s and warming within the 1980s-90s) affect the air temperature variation with a period about 50-60 years defined during ice core analysis. These oscillations also influence the earth's rotation speed and the solar activity index.

The cyclic oscillations of the shorter duration (5-7, 10-12, 19, etc., years) are of a more complicated structure. The observed conjugation of processes in atmosphere and ocean is analyzed, and the regional specific features of this cyclic recurrence are defined.

The possible reasons for cyclic changes of the climate and the processes of cyclic oscillation forming are discussed.

COOPERATIVE MASTER PROGRAM FOR APPLIED POLAR AND MARINE SCIENCES AT SAINT PETERSBURG STATE UNIVERSITY

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Russian and German universities and research institutions have joined for the purpose of educating a new generation of highly qualified young scientists in the field of applied polar and marine sciences. Within the framework of this international network a cooperative faculty will be established at the St. Petersburg State University. A master course in Applied Polar and Marine Sciences is planned to start in October 2002. The master will be approved in both countries and will get a certification according to European standards. Within two years basic and advanced knowledge of various fields of polar and marine sciences will be imparted. Field excursions and practical work will ensure the applied aspect of the program of study. The Russian-German Otto-Schmidt-Laboratory will support the master program with practical courses and will assure the contact to running bilateral research programs in polar and marine sciences. The master program is funded by the participating universities and institutions and the German Academic Exchange Service (DAAD).

THERMOKARST FORMATION AT THE END OF THE LATE PLEISTOCENE AND HOLOCENE AND ITS IMPACT ON THE PERMAFROST OF THE EASTERN PART OF THE RUSSIAN ARCTIC

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The Russian Arctic eastward from Taymyr Peninsula never underwent glaciation. The sea regressions-transgressions have a glacioeustatic nature and concurred with climate cooling-warming cycles. The vast shallow shelf fell dry up to hundreds of kilometers to the north. Permafrost up to 500-600 m thickness was formed on the exposed shelf. Ice-rich syncryogenic deposits of the Ice Complex (IC) were formed on the coastal lowlands and the shelf during the Late Pleistocene. IC thickness reaches 60 m in the limits of negative neotectonic structures. Its volume of ice content reaches 80-95%. Widespread thermokarst lake formation on the coastal lowlands and drained shelf started at the end of the Late Pleistocene (about 12.8 kyr BP). The sea level at that time was lower than the modern one by 80-10 m. The formation of thermokarst lakes leads to the thawing of IC and accumulation of its organic and mineral components („taberal deposits“) on the lake bottoms. During this stage of termokarst formation the depth of the lake taliks was equal to thickness of taberal deposits.

A mathematical model of the thermokarst lake and lake talik formation was created. The model takes into account the geocryological and climate zonation, IC thickness and its ice content, lake enlargement by shore thermoerosion etc. Results of computer simulation

showed that for the complete thawing of IC with a thickness of 10 to 60 m took 300-4000 years, respectively. Lake talik formation in underlying deposits begun only after complete IC thawing. During this period the depth of the thermokarst lake and the lake bottom temperature equalling +2°C were determined as constant. Lake taliks were closed and their thickness on the shelf were less than 150-200 m. The open lake taliks may exist only under lakes which have been formed over fault zones with high geothermal heat flow. Due to sea transgression thermokarst lakes were transformed into thermokarst lagoons and lake taliks were submerged by the sea and formed subsea taliks. The latter made by silty deposits may freeze if the sea water has a negative temperature (–1.0 to -1.5°C) and a subsea pingo develops. Subsea taliks composed of sands are saturated with sea water. According to simulation results relic permafrost exists under most of the shelf. The subsea permafrost table on the shelf is very uneven due to the existence of closed submarine taliks. On the coastal lowlands thermokarst lakes and lake talik formation takes longer than on the shelf, but most of the taliks are closed too. Most of the thermokarst lakes changed into alas. Alases and thermokarst lakes occupied up to 50% of the lowlands area. Permafrost thickness under thermokarst forms was reduced. The thermal impact of the thermokarst phenomena on the permafrost thickness was more intense than the climate warming impact of the Holocene Optimum. On the lowlands and inner part of the shelf permafrost is continuous with the exception of closed lakes and subsea taliks.

HIGH RESOLUTION RECORDS OF TEMPERATURE CHANGE DURING THE LAST MILLENNIA IN HIGH LATITUDES OF SIBERIA

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In several regions of northern Siberia the forest sites were found with trees of more than 800 years of age and with abundant well preserved wood of dead tree trunks and also in the alluvial deposits of small rivers. Wood material sampling, its cross dating by dendrochronological methods, as well as its radiocarbon dating allowed to establixh the tree ring chronologies for the Siberian north for some millennia. Owing to the high correlation of the tree ring width variability with summer temperature these long- term chronologies were the source for the quantitative reconstruction of temperature change. Proxy record analysis clearly revealed a medieval warming of 900- 1200 years in the north of Eurasia during which the temperature was even higher than its maximum values in the current warming. The analysis showed also that the temperature in this subarctic sector in the Climatic Optimum of the Holocene exceeded the current one by 3- 3.5°C. A comparison of temperature change in the long- term tree ring chronologies with the change of the main climatic forcing factors points to the significant influence of changing solar irradiation, volcanic activity and carbon dioxide concentration in the atmosphere. The problems of using the high resolution records for calibration and verification of the other climatic proxy data are also discussed.

GEOLOGICAL ENVIRONMENT CHANGES OF WESTERN RUSSIA COASTAL ZONE BY CLIMATE WARMING

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Thermodenudation of the Arctic seas coasts is among the most active permafrost-related geological processes which cause the exposing of various multi-layered sedimentary units in the coastal scarps. The study of these sedimentary sections provides information both for paleo-permafrost reconstruction and for the estimation of present coastal system variations due to climate warming.

Two main areas in the Kara sea region were selected for the field work: station Marre-Sale at the west coast of Yamal Peninsula and Shpindler Area at the coast of Yugor Peninsula.

The systematic observation of the shore retreat rate of Marre-Sale was begun in 1978. Observations were carried out annually on a thermally eroded coast about 4.5 km long. More than 60 section lines were arranged in a normal direction to the coastline. As an observation result it has been stated that temporal changes in retreat rate show a cyclic nature. Periods of fairly low retreat rates alternate with those of high rates. The entire cycle period is about 20 years.

In 2001 a preliminary study under the new comprehensive program was carried out based on not only earlier results but also on data obtained using advanced geodetic and DGPS technologies. The coastal monitoring site has been considerably expanded in order to cover both the thermally eroded and accumulative types of the coast (Marre-Sale dune region about 40 km southward from the main key site).

According to our reconstruction the coastline retreat at the Marre-Sale key site between 1941 and 2001 ages is about 147 m. Coastal deposition trends beyond the 60 yr in the Marre-Sale dune region need further investigation and a search for available cartographic, ancillary data and aerial images.

These natural study objects involve a sequence of unconsolidated deposits we studied in 1998-1999 on the Yugor Peninsula, 40 km east of the village of Amderma near a Shpindler Area.

It would appear reasonable that these calculations are considered interesting in the temporal trend allowing for the calculation of the thermoabrasion rate in the littoral zone. A visual survey we conducted and compared with the results of deciphering the aerosurvey of different years (1947 and 1969 in particular) permitted to calculate thermoabrasion rate for the region to be of 3 m per year.

The data available on shore thermoabrasion allowed to compile a principal chart of geochemical processes of the environment degradation in the arctic littoral zone as a result of climatic warming. Pertinent to this chart we attempted:

- to calculate the volume of oxygen consumed in the course of oxidation of the regenerated forms of elements in frozen rocks under destruction;
- to calculate balance masses of organic carbon involved in the global carbonic cycle in the course of destruction of sedimentary formations of the littoral zone;
- to define the mass of fine-dispersed particles brought into near-shore water in the course of destruction of frozen rocks and to estimate their lateral distribution in the recent surficial layer of bottom sediments.

The following conclusion may be drawn from the results obtained:

The volume of oxygen consumed during melting of frozen rocks of the arctic shore is comparable by the order of values with that consumed during water photodissociation H_2O-->H_2+O in the upper atmospheric layers being the main abiogenic source of oxygen supply to the atmosphere.

The volume of oxygen required for Fe (II) oxidation during annual melting of frozen rocks is contained in about 1 km^3 of water. With no rapid exchange of water masses inside a basin (due to formation of bars), the oxygen contained in the water of the littoral zone will be absolutely exhausted for iron oxidation, which will cause the complete stagnation of littoral zones and the development of anaerobic processes accompanied by hydrogen sulphide admixture.

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DYNAMICS OF VEGETATION AND PEAT ACCUMULATION IN THE WEST SIBERIAN PLAIN DURING THE HOLOCENE

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Within the framework of the INTAS Project 99-1718 "Climate in relation to carbon accumulation: spatial and temporal analyses of West Siberian peat ecosystems (CIRCA)", the dynamics of peat accumulation in West Siberia was investigated. This report is based on the detailed palynological studies and radiocarbon dating of three key sections, situated in

southern, middle and northern taiga sub-zones of the West Siberian Plain, as well as on the previously published data. These data permit us to reconstruct specific features of vegetation history in the three sub-zones of the taiga and thus infer the climatic changes, important for the process of peat accumulation.

According to the available data, the process of paludification spreads rapidly over the entire taiga zone of West Siberia at 9-8K ^{14}C yrs B.P. Rare earlier dates of peat initiation correspond mainly to the sites where peat accumulation began due to the terrestrialization, so that the fens were formed locally in place of small lakes (e.g. ox-bow lakes). Apparent peat accumulation rate generally slowed down in the time interval from 7 to 5Kyrs B.P.

Palynological data on Zhukovskoye (southern taiga), Nizhnevartovsk (middle taiga) and G-18 (northern taiga) sections indicate that this interval was the warmest part of the Holocene, when such relatively thermophilous species as Siberian fir spread over the plain, and pollen of the broad-leaved trees (mainly *Ulmus*, but also *Tilia* and *Quercus*) appeared in the spectra. The warming brought about an increase in potential evaporation and therefore a decrease in effective moisture. Consequently, at some sites peat accumulation slowed down and even stopped, as evidenced by interlayers of woody peat or forest litter with tree stumps *in situ*. At the other sites with sufficient ground moisture supply a decrease in the apparent accumulation rates might have resulted from faster peat decomposition even without the actual decrease in the accumulation rate.

In the Subboreal (after app. 4.5Kyrs B.P.), due to the gradual cooling and increasing effective moisture, peat accumulation resumed or continued with increased rates, with the exception of some sites (frozen peat hummocks) where the post-Atlantic peat layers are absent. The process of peat growth generally slowed down again in the Subatlantic (the last 2.5Kyrs), thus reflecting further cooling.

MICROBIAL CONTROLS ON METHANE EMISSION FROM SIBERIAN TUNDRA ENVIRONMENTS: OPEN QUESTIONS AND FUTURE PERSPECTIVES

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Within the framework of a 3-year study, the CH_4 emission from ice wedge polygons and the involved microbial processes (CH_4 production and oxidation) were investigated in the Lena-Delta, Siberia.

In situ CH_4 production in the centre of the polygons (*Typic Historthel*) varied between 0.3–38.9 nmol h^{-1} g^{-1} dry weight of soil. The highest activity could be determined in the peat layer of the top soil. After the addition of methanogenic substrates (acetate, H_2), the activity drastically increased. The CH_4 production in the peat layer with H_2 as substrate was about 1.5 times higher (11.3 nmol h^{-1} g^{-1}) compared with acetate (7.8 nmol h^{-1} g^{-1}) as substrate, while above the permafrost table at temperatures between 0°C and 3°C the activity were in the same order of magnitude (1.2 nmol h^{-1} g^{-1}) with both substrates. This result points to a methanogenic microflora adapted to low temperatures in the cold permafrost habitat.

The CH_4 oxidation is controlled, among other factors, by soil moisture, which was reflected by the seasonal variability of the CH_4 emission. If the soil was water-saturated like at the beginning of the season, CH_4 oxidation was only detectable in the top soil (0,6 nmol h^{-1} g^{-1}). This resulted in a high CH_4 emission rate (approx. 50 mg d^{-1} m^{-2}). In the course of a seasonally sinking of the water level, the top horizons of the soil became drier and changed to oxic conditions. Under these conditions, CH_4 oxidation activity was observed for almost the whole vertical profile, which led to a lower CH_4 emission. The CH_4 oxidation reached an activity of 5.3 nmol h^{-1} g^{-1}, which was in the same range like the CH_4 production. Nevertheless, CH_4 emission occurred in the order of 25 mg CH_4 d^{-1} m^{-2}, because of the low CH_4 turnover rate at *in situ* concentrations of the CH_4 oxidising bacteria. Additionally, a part of the CH_4 is released to the atmosphere via the vegetation, so that the CH_4 oxidation in the top soil is bypassed.

Since substantial parts of the carbon conversion are catalysed exclusively by microorganisms, the search for key-organisms as well as the identification and diversity studies of the microbial community are an essential future task for the understanding of carbon fluxes in permafrost soils under changing climate conditions.

ACOUSTIC DOPPLER CURRENT PROFILER – A TOOL FOR THE DETERMINATION OF SEDIMENT TRANSPORT DYNAMICS ON ARCTIC SHELVES

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Primarily Acoustic Doppler Current Profilers (ADCPs) are used for the investigation of current systems. But additionally ADCPs provide information on particle concentration within the water column by echo intensity. Echo intensity depends on sound absorption, beam spreading, transmitted power, and backscatter coefficient. At low concentrations (<100 mg) the sound attenuation due to sediment in the sound path is low, resulting in an increase in the intensity of backscattered sound with increasing particle concentration. As the relationship of echo intensity to particle concentration strongly depends on particle size a calibration of the relationship with *in situ* measurements is absolutely necessary. Due to investigations on suspended matter in the Laptev Sea (Siberian Arctic) the suspended particle size spectrum can be assumed to be more or less constant for various years and seasons, especially in the near-bottom layer.

During the TRANSDRIFT VIII expedition in 2000 bottom-moored ADCPs were deployed on the Laptev Sea shelf (Siberian Arctic) on three long-term stations (monitoring-period: at least 28 hours). For a calibration of the acoustic echo intensity, turbidity meter measurements were carried out hourly. Every four hours waters samples of two liters each were collected from various water depths to determine the *in situ* particle concentration. Using this calibration, the echo intensity signals have been inverted to give time series profiles of particle concentrations. The range of echo intensity (20 – 150 dB) during the TRANSDRIFT VIII expedition corresponds to the echo intensity range of the bottom-mooring stations, which were deployed at key positions on the Laptev Sea shelf for the period of one year in 1998. Therefore the one-year echo data could be inverted to particle concentrations as well, which has given new insights into the transport dynamics since current conditions and particle concentrations within the water column were recorded simultaneously. Therefore ADCPs provide an excellent tool for the determination of transport dynamics especially on Arctic shelves, as they are exceedingly difficult to reach, especially during the time of ice-coverage.

SEASONAL SEDIMENT DYNAMICS ON THE LAPTEV SEA SHELF – IMPLICATIONS FOR SEDIMENT BUDGET CALCULATIONS

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Even though shelves contribute in major proportions to the entire sediment input of the Arctic Ocean, studies on budgets are rare. The Laptev Sea shelf as one of the largest Siberian shelf seas is ice-covered for about nine months a year. Transport processes below the ice cover are hardly known, which makes sediment budget calculations incomplete. During the TRANSDRIFT V expedition in 1998 two long-term stations were deployed at key positions in the eastern Laptev Sea to gather broadband ADCP (Acoustic Doppler Current Profiler) and CTD (Conductivity Temperature Depth Meter) data for the period of one year. Besides data on current velocity and direction, ADCPs provide data on particle concentrations in the water column as well. Therefore these data have given new insights into sediment transport dynamics for the whole course of the year. Seismic profiles were used to support the annual records for a general concept of sediment transport on the Laptev Sea shelf.

During the ice-free months material transported onto the shelf by riverine input and coastal erosion is kept in suspension mostly within a bottom nepheloid layer (a layer of increased sediment concentration within the water column). Resuspension of bottom material takes place during and after storm events, clearly indicating the atmospheric forcing of sediment transport. The submarine palaeo-river valleys are transport conduits for this time of the year and even for a long time after the freeze-up. In areas below the polynya bottom currents after storm events are still high enough to resuspend material from the seafloor. This might explain the small Holocene coverage and small sedimentation rates in the valleys. Material from the shoals, e.g. Stolbovoy Bank, is resuspended and transported over the shoals into the troughs where it settles close to the slopes. If higher storm frequencies coincide with later freeze-up they can cause even higher rates in resuspension. This might lead to a higher amount of sediment transported over the shelf edge into the deep Arctic Ocean. Therefore seafloor erosion and interannual transport dynamics have to be taken into account for sediment budget calculations as they are determining factors for sediment availability and the proportion of deposition and erosion.

II. KIHZ - NUMERICAL MODELLING IN PALEOCLIMATOLOGY

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Within the German project KIHZ (Klima in Historischen Zeiten, climate in historical times) several numerical modelling strategies are being applied in the context of paleoclimatic research. The common goal is the reconstruction of large-scale climatic variability, such as the Arctic and Antarctic Oscillations, and the understanding of the underlying processes. The different approaches are discussed, and first results are presented. Three types of numerical models are currently used within KIHZ, namely coupled atmosphere-ocean General Circulation Models (GCMs), models of intermediate complexity (ICMs) and high-resolution regional models (RCMs). One type of numerical experiments uses GCMs and ICMs for assimilation of paleoclimatic data, in order to reconstruct the historical climate during the Late Holocene. Another experiment type undertaken uses free and externally forced runs of the same models to investigate the internal variability of the climate system and the contribution of external forcings, such as changes in solar radiation, and varying concentrations of CO_2, CH_4, and aerosols. These runs can be compared with proxy data, bearing in mind that an externally forced run will at best yield a random realization of the climate that is consistent with the forcing, rather than the actual historical climate. High-resolution simulations with RCMs were performed for instance for two warm and two cold periods in the Baltic region and the Arctic. This yields a better understanding of the local effects of large-scale climate changes, which in turn is needed to understand the links between proxy records and the large-scale climate.

BOTTOM CURRENT-CONTROLLED SEDIMENTATION AND MASS WASTING IN THE NORTHWESTERN SEA OF OKHOTSK

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Quaternary sedimentation in the northwestern Sea of Okhotsk is characterized by the following processes: (1) bottom current-controlled sedimentation, which leads to widespread deposition of contourite drifts and sediment waves on the North Okhotsk continental margin and the northernmost East Sakhalin slope, as well as to erosion and sediment reworking on the northern East Sakhalin shelf; (2) mass wasting triggered possibly by very high sedimentation rates, earthquakes and perhaps shallow gas occurrence in a fault zone, resulting in the deposition of slumps and debris flows in the western Derugin Basin; (3) deposition of fluvial material transported by the River Amur during the warm season of interglacial periods when there is no sea-ice cover; and (4) quiescent hemipelagic sedimentation of biogenic material and ice-rafted debris, possibly interrupted by episodic

turbidity current activity. This results in hemipelagites with turbidite intercalations, especially in the Derugin Basin and its northern, eastern and southern flanks. The bottom currents are thermohaline in origin or tidally-induced and are controlled by the hydrological regime in the Sea of Okhotsk, which is very likely closely connected to the intermediate and deep water circulation patterns in the northern Pacific.

THERMODYNAMIC CONSIDERATION OF EQUILIBRIUM OF CO_2-HYDRATE IN SEA WATER

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Gas hydrates have attracted the attention of many investigators from different points of view: 1) gas hydrates are a source of problems for the energy industry in the field of gas transportation, when gas pipelines are used; 2) natural gas deposits in the form of solid gas hydrates including CO_2-hydrate were discovered; 3) the microthermometric measurements of the dissociation temperature of CO_2-hydrate in saline aqueous inclusions are used as a powerful tool; 4) the idea of CO_2 storage on the seafloor in form of CO_2-hydrates is one of the promising options for the reduction of CO_2 emission into the atmosphere.

The stability of CO_2-hydrate in sea water, solubility of hydrate and pH of sea water equilibrated with hydrate were examined by means of the Pitzer method.

The empirical equations for dissociation pressure and solubility of CO_2-hydrate in sea water were developed as a function of temperature, hydrostatic pressure and salinity from available thermodynamic data.

It was obtained that the solubility of CO_2-hydrate increases when the temperature increases and the hydrostatic pressure decreases. In comparison to liquid CO_2, hydrate reduces the major environmental impact of the ocean`s CO_2 disposal, because sea water equilibrated with hydrate can have higher pH values than sea water equilibrated with liquid CO_2.

THE LAGO GRANDE DI MONTICCHIO (ITALY) – A HIGH-RESOLUTION ARCHIVE FOR PALAEOENVIRONMENTAL AND TEPHROSTRATIGRAPHICAL INVESTIGATIONS OF THE LAST 101 KA

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The study of maar lake sediments has a high potential for palaeoclimatic and palaeoenvironmental reconstructions. Such deposits with sedimentation rates of much higher magnitude than marine records make available information of the past with a high temporal resolution. The sediments recovered from the maar lake Lago Grande di Monticchio are ideal for applying palaeoclimate investigations. The Lago Grande di Monticchio is situated in the Monte Vulture volcanic massif about 120 km east of Naples (southern Italy) and formed during the last phreatomagmatic eruptions of Monte Vulture at least 130 kyr ago. Several sediment cores with a maximum length of 65 m were recovered from Lago Grande di Monticchio in 1990 and 1994. Detailed interdisciplinary studies on sedimentology, geochemistry, palynology, palaeomagnetism and tephrochronology have been carried out demonstrating a great potential of this site for palaeoenvironmental reconstruction. An independent chronology of the partly varved sediments (10%) of Lago Grande di Monticchio has been established by counting the annual laminations and by interpolation of sedimentation rates for non-varved sections. This varve supported sedimentation rate chronology reaching back to 101 ka has been confirmed by a high-resolution tephrochronology, numerous radiocarbon datings for the upper part of the profile and three 40Ar/39Ar datings on prominent tephra layers (error < 5%).

The multi-proxy data from Lago Grande di Monticchio indicate a highly variable environment during the last glacial/interglacial cycle with numerous short and abrupt changes. Periods of increased erosion in the lake catchment coincide with low contents in arboreal pollen and diatoms, which are interpreted as environmental deterioration. Based on independent chronologies, these periods have been correlated to cold phases recognized in ice-core and deep-sea records. Dating discrepancies between the Monticchio and the ice-core and deep-sea chronologies range from a few hundred to a few thousand years. However, these deviations in dating are not constant but vary significantly for different sections of the record.

In addition to its value as a high-resolution palaeoclimatic archive, the Monticchio record has become a key position for inter-site correlation in the Mediterranean within the ELDP (European Lake Drilling Programme). This is mainly due to the large number of intercalated tephra layers (n=344) within the Monticchio sediments representing independent time and correlation horizons. By using numerous well-dated tephra layers, all originating from Central and South Italian volcanoes, it is possible to compare palaeoclimatic proxy from terrestrial sequences of Central Italy and particularly from marine deep-sea cores of the Tyrrhenian, Adriatic and Ionian seas. Having this data on hand and in combination with tephra layers originating from the Hellenic Arc, it is also possible to link records from the Central Mediterranean with terrestrial and marine sequences from the Eastern Mediterranean and Levantine Sea (Near East). On the other hand, a correlation with other terrestrial European records (e.g. Lac du Bouchet, Lac de Joux) has been established by the comparison of geomagnetic paleosecular variations.

NATURAL GAS AND GAS HYDRATE ASSOCIATION IN PERMAFROST OF WEST SIBERIA

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Numerous intensive gas liberations from permafrost interval have been documented for shallow depths in a number of permafrost regions (such as North Siberia, Arctic coast of Canada and Alaska and others).

First studies of permafrost gas accumulations have been made at the Yamburg gas field (North of West Siberia) at the end of 80ies. These studies indicated the microbial origin of the majority of the gas blowouts and their genetic link to permafrost formation.

The northwestern part of Yamal Peninsula where large natural gas accumulations were discovered in the permafrost section, is one of these areas. The main natural gas accumulations (methane of microbial genesis with measured flow rates at wellheads up to 10,000 m^3/day) are concentrated at the depths of about 60-80 meters. Special studies, which included the analysis of the permafrost lithology, cryogenic structure, gas composition and pore water geochemistry, as well as a detailed study of permafrost drill cores recovered were carried out. Based on these studies it can be assumed that at least a part of the gas in such intrapermafrost accumulations exists in the shape of relict gas hydrates. They were formed in the past and exist now due to the self-preservation effect.

High gas saturation of permafrost, both in plan and in section, large gas flowrates at wellheads (hundreds and thousands m^3/day) at a high (up to 99 %) degree of pore filling by ice and unfrozen water confirm gas hydrate existence in the permafrost section. Also it was documented that gas liberations are tidal to the soil zones with reduced salinity. And an increase of the general rock salinity is noted beneath the gas-containing horizons. These data could indicate the process of salts concentration due to section freezing and local hydrate formation. The analysis of underground water has demonstrated that intrapermafrost mineralized waters are also located beneath the intervals of gas-containing permafrost layers.

The results of special laboratory measurements of permafrost gas content during core defrosting in the gas-selector also confirmed hydrate presence. The volume of gas selected during core defrosting exceeded the free pore space of sediment by two-three orders.

Experimental modelling of gas hydrate formation/decomposition P/T conditions in the permafrost sediment cores also demonstrated the ability of gas hydrate accumulation in pore space.

The possible mechanism of gas and gas hydrate association formation within permafrost is suggested on the basis of the study.

TRANSITION FROM THE GAKKEL RIDGE TO THE LAPTEV SEA SHELF

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The uniqueness of the transition zone from the Gakkel Ridge to the Laptev Sea shelf motivates many researchers to continuously improve old and propose new models of structure and evolution of the lithosphere of the "mysterious" region. Under the State Program of 1:1,000,000 geological mapping, the majority of existing geophysical data (magnetic, gravity, bathymetry and seismic) for the Russian Arctic shelf were processed and analyzed using modern computer technologies.

To explain the observed negative axial magnetic anomaly over the southern end of the Gakkel Ridge, modeling along the seismic profile MAGE 90700 was executed. It appears that the mean ultra-slow spreading rate for the Eurasian Basin may, in fact, be explained by the discreet nature of spreading processes that were characterized by alternations of periods of low-rate spreading and complete lack of spreading. There was no spreading during the last 550,000 years; this period was preceded, at least on the western flank of the ridge, by spreading at a 4 mm/year rate that persisted since 9.5 Ma (linear magnetic anomaly number 5). Before then, the spreading rate seemed to be around 6 mm/year.

The results of gravity modeling along representative seismic lines show the contrasting relief of the Moho. The lack of gravitational masses observed under the ridge axis indicates the presence of a heated mantle whose partial crystallization during the periods of lack of spreading led to crustal underplating. This newly accreted crust could have a reverse magnetic polarity as compared to the overlying older crustal layer. The resulting effect of such superposition of reversibly polarized crustal layers could be reflected in the partial distortion of the earlier magnetic field pattern and in a diminishing of the range of anomalies amplitude.

The obtained results correspond to modern spreading models that show that the time between accretion pulses for ultrahigh ridges is about the first thousands of years, for slow ridges about the first tens of thousands of years, and for ultraslow ridges about the first hundreds of thousands of years.