Russian-German Cooperation:

The Expedition TAYMYR 1995

and the

Expedition KOLYMA 1995 of the ISSP Pushchino Group

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1 INTRODUCTION

(H.-W. Hubberten and D. Yu. Bolshiyanov)

As the northernmost region of the Eurasian continent, the Taymyr Peninsula is one of the most interesting of the Arctic (Fig. 1-1). Together with the Severnaya Zemlya Archipelago north of it, the entire spectrum of Arctic landscapes, from the northern boreal forest and forest tundra across the typical tundra zones to the Arctic desert is covered in a north-south transect of about 1400 km.

In order to investigate the paleoclimatological and paleoenvironmental changes which occurred in that area during the Late Quaternary, a joint Russian-German research project was initiated in the year 1992. After a pilot expedition to the area of Norilsk and to the Taymyr Peninsula in 1993, the research project "Late Quaternary Environmental Development of Middle Siberia" was initiated and has being funded since 1994 by the German Ministry of Education, Science, Research and Technology (BMBF), the Russian Ministry of Science and Technical Policy, and other institutions.

The overall goal of the project is the reconstruction of the paleoenvironmental changes which occurred in the area of investigation during the Late Quaternary climatic fluctuations, i.e. the last glacial-interglacial cycle since the Eemian (ca. 110,000 years). For this objective, natural archives as lake sediments and syngenetic permafrost records are used in combination with paleogeographic studies. For the interpretation of the information obtained during field and laboratory studies a detailed knowledge of recent processes going on in the "Permafrost-soil-hydrosphere-biosphere" system under different climatic conditions is indispensable. For this reason major emphasis is put on this kind of study along the South-North transect using multi-disciplinary investigations. Within the context of anthropogenically caused changes in the system Earth, studies on the behaviour of the green-house gases methane and carbon dioxide are carried out, which are stored in large amounts in the permafrost soils. Contamination and ecological investigations are also part of the project.

The studies were conducted in accordance with the aims and purposes of the NTP direction 4 of the AARI: "To investigate the state of the natural environment of the Russian Arctic and its change under the influence of anthropogenic impact" and with the perspective plan for Russian-German cooperation in studies of the polar regions of the Earth.

The direct goal of the 1995 field season was to obtain full-scale data on the current state of the lake - river systems of the Taymyr peninsula, the history of their development and current changes as affected by anthropogenic factors.

The objectives of the 1995 expedition included:

- to obtain long (up to 10 m and more) bottom sediment cores of lakes of the Taymyr Peninsula for conducting paleoclimatic and paleogeographic studies;
- to investigate the geomorphological structure, current geomorphological processes and structure of the Quaternary deposits of the Taymyr Peninsula for paleogeographic reconstructions and characteristics of the anthropogenic influence on the relief;
- to continue geocryological-paleogeographical investigations in the Labaz Lake area (eastern part of the Taymyr Lowlands);
- to realize pedological and microbiological studies at the Labaz Lake and the Levinson Lessing Lake areas;
- to collect hydrometeorological data (surface runoff and runoff in the active ground layer and permafrost deposits) for calculating the water balance of the

lake - river system of the Levinson-Lessing Lake and estimating the runoff in the lake - river system of the Taymyr Lake;
- to conduct a snow-measuring survey of the central Taymyr peninsula for calculating moisture supply into the lake - river system of the Taymyr Lake;
- to sample snow, water and ice in the central Taymyr peninsula for estimating the extent of pollution of the atmosphere and clearing up the pathways of pollutants in the atmosphere.
To carry out a reconnaissance study on the Severnaya Zemlya Archipelago as a basis a for planning lake sediment sampling during the 1996 expedition as well as preliminary pedological and microbiological studies.
Data obtained through AARI activities on the Taymyr peninsula beginning in the 1930s, as well as successful studies during the field seasons of 1993 (Melles, 1994) and 1994 (Siegert and Bolshiyanov, 1995) carried out jointly by AARI staff and German scientists from the Alfred Wegener Institute for Polar and Marine Research served as a basis.

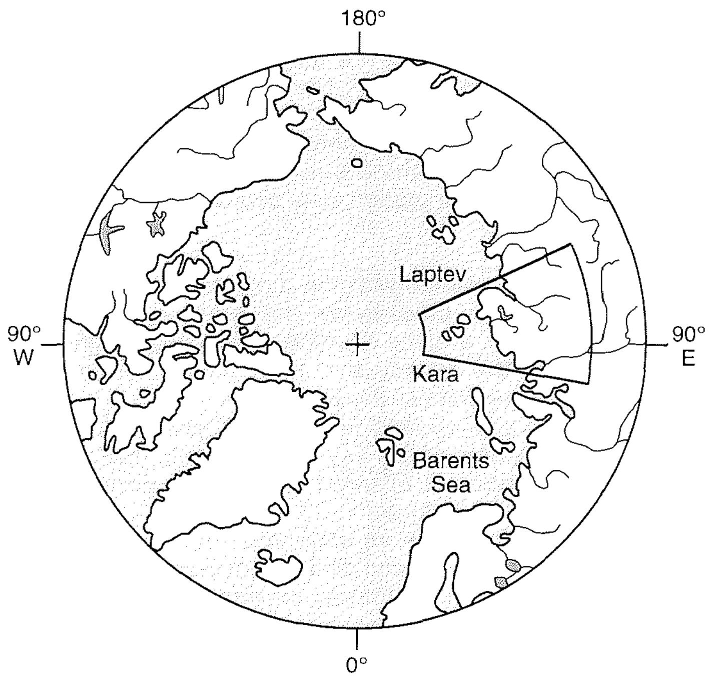


Fig. 1-1: Map showing the location of the Taymyr Peninsula and the Severnaya Zemlya Archipelago (encircled)

2 SUMMARY AND EXPEDITION ITINERARY
(D. Bolshiyanov and H.-W.Hubberten)

2.1 Time frame, regions and scope of work

The logistical operations of the 1995 expedition were organized by the AARI. The German expedition equipment was sent to St. Petersburg from Bremerhaven using a 20ft container shipped by a cargo vessel. The transport of equipment and expedition members to the field was made by regular or charter flights from St. Petersburg. The entire field season was divided into four stages, which were subdivided according to specific scientific objectives or studied areas (Fig. 2-1).

1 stage (April 27-June 9, 1995).

This was the most difficult stage with respect to scientific, logistical and physical aspects. During this period a large territory of the Taymyr peninsula was covered by studies.

April 27 - departure of the participants in the 1 expedition stage with most of the expedition cargo from St. Petersburg to Khatanga by a IL-18 charter flight of the "Mir" air company.

April 28-29 - preparatory operations in Khatanga;

April 29 - May 6 - sampling of bottom sediments at the Kokora Lake (a small satellite lake of the Labaz Lake - 72°50'N, 99°50'E);

May 4-5 - snow measuring survey in the Labaz Lake region (2 traverses with sampling for pollution determination);

May 7 - flight to the Portnyagino Lake (74°50' N, 10°50' E) by MI-8 helicopter and AN-2 aircraft;

May 8-13 - sampling of bottom sediments at the Portnyagino Lake (1 traverse with sampling for pollution analyses);

May 14 - flight by aircraft to the Taymyr Lake;

May 15-20 - sampling of bottom sediments on the Taymyr Lake;

May 16-19 - snow measuring survey using AN-2 aircraft along the route Cape Cheluskin - Khatanga settlement (10 snow measuring profiles with snow sampling for pollution analyses);

May 21 - flight of the group by AN-2 aircraft to the Levinson-Lessing Lake;

May 22 - June 4 - collection of bottom sediment cores at the Levinson-Lessing Lake;

May 23 - June 7 - a measuring survey in the Levinson-Lessing Lake and over the water catchment area of the Krasnaya river (14 traverses with sampling of snow and ice for pollution analyses);

June 4 - 6 - change of the base of the expedition camp from the center of the Levinson-Lessing Lake to the northern shore, arrival of participants in the second expedition stage;

June 6 - October 11 - meteorological observations in the region of the northern camp at the Levinson-Lessing Lake (temperature, atmospheric pressure, wind speed and direction, cloudiness, precipitation);

June 11 - departure of the participants of the first stage of the expedition from Khatanga to St.Petersburg by regular Aeroflot flights via Norilsk.

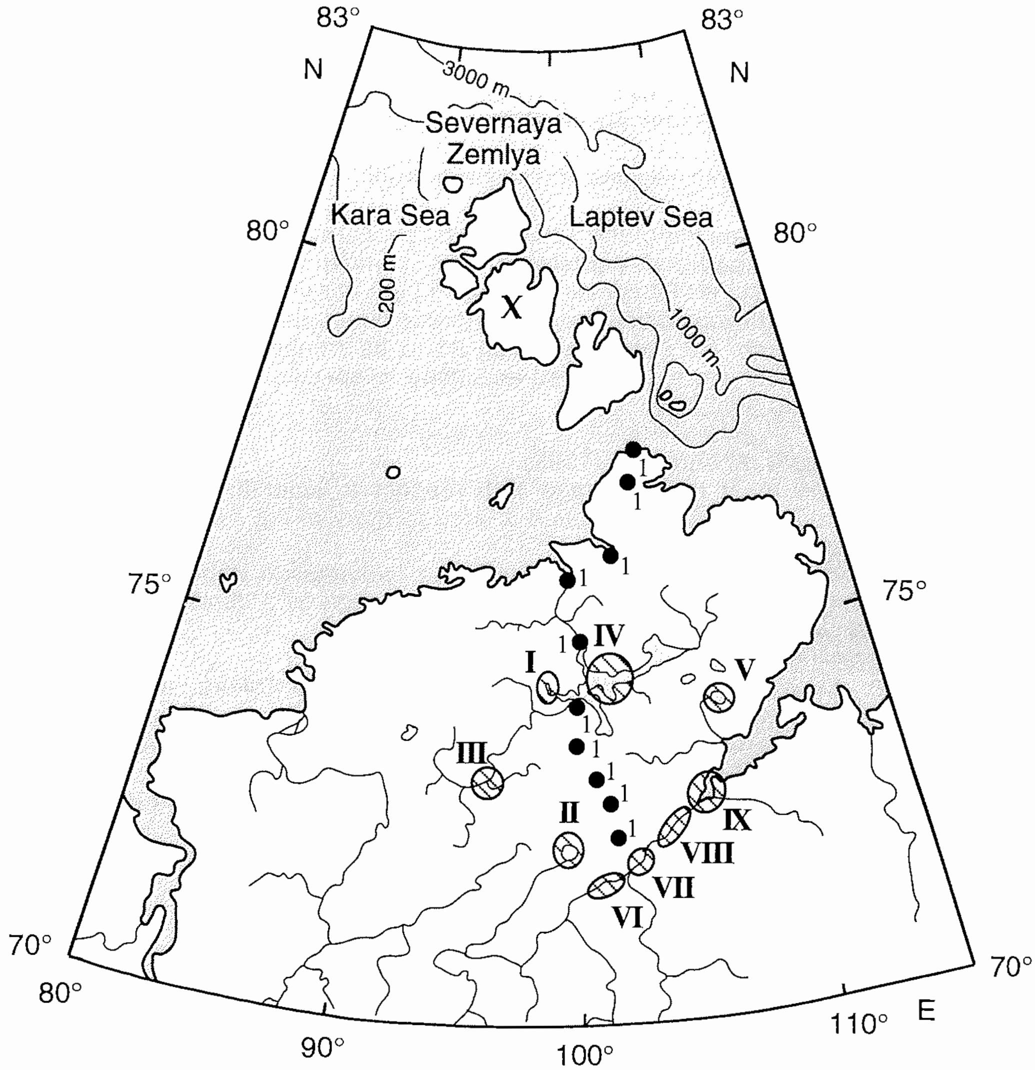


Fig. 2-1: Data distribution map of Taymyr Peninsula

No.	investigated area	kind of investigation
I	Levinson-Lessing Lake	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12
II	Labaz Lake	1, 2, 3, 4, 6, 9,1 0, 11, 12
III	Lagota River	1, 5, 6, 9, 10
IV	Taimyr Lake	1, 2, 3, 6, 9, 10
V	Portnyagino Lake	1, 2, 3
VI	Kheta River	8
VII	Khatanga	8, 9, 10
VIII	Khatanga River	6, 8, 9
IX	Novorybnoe	6,9
X	Severnaya Zemlya	9, 12

Kind of investigation: 1 - snow cover studies; 2 - lake sediment sampling; 3 - Limnological studies; 4 - meteorological studies; 5 - hydrological studies; 6 - paleogeographical and geomorphological studies; 7 - landscape studies; 8 - geobotanical studies; 9 - ecological and ecological-hygienic studies; 10 - radioecological studies; 11 - geocryological and paleogeographical studies; 12 - soil science studies

2 stage (June 9 - July 18, 1995).

The region of the Levinson-Lessing Lake:

June 9 - replacement of the participants of the 1st stage by the participants of the 2nd stage. The hydrological section No.1 was set up on Krasnaya river and observations were organized.

June 9 - October 7 - hydrological observations at the Krasnaya river (51 discharges), Protochny stream (9 discharges) and streams No.1, 2, 3 (5 discharges each), with measurements of water temperature, turbidity and electrical conductivity.

June 11 - June 17 - drilling of permafrost 1.5 km east of the camp with core recovery;

June 11 - October 10 - limnological observations at two vertical profiles within the Levinson-Lessing Lake (changes in temperature regime, turbidity, pH, electrical conductivity, water sampling);

June 13 - September 15 - observations at solifluction profiles (9 observations);

June 26 - October 10 - measurements of water level and temperature in the Levinson-Lessing Lake (the northern shore);

The region of the Logata river mouth:

flight onboard MI-8 along the route Khatanga settlement - Logata river mouth; return from the Logata river mouth to the Khatanga settlement.

3 stage (July 15-September 6 1995).

During this stage studies were performed in three regions (Levinson-Lessing Lake, Labaz Lake, Logata river mouth) and the pilot expedition to Severnaya Zemlya was carried out. In addition to the continuation of the work of the previous stages - hydrological, limnological observations of the dynamics of the active layer, observations of the solifluction processes, sampling for different kinds of pollution. - Studies of microbiological processes in the soil, geomorphological studies, paleogeographical studies and botanical studies were commenced.

New studies of this stage were geomorphological studies, lichenological activities, cryolithological studies. In addition to the region of the Levinson-Lessing and Labaz Lake, the geomorphological studies included the region of the Ledyanaya river.

July 15 - a group of 14 scientists (8 Russian and 6 German) used a charter flight of IL-18 from St.-Petersburg to the Khatanga settlement.

The Levinson-Lessing Lake:

During the work at the third stage in the Levinson-Lessing Lake the following observations were continued: observations at hydrological sections (Krasnaya river, Protochnay stream); limnological observations of the active level at profiles established during the 1994 field season.

July 19 - a group of 5 people (4 Russians and 1 German) was delivered by one flight of MI-8 to the work site on the northern shore of the Levinson-Lessing Lake where at that time 2 hydrologists (1 Russian and 1 German) were continuing the work of the second stage.

July 21 - August 28 - landscape, geomorphological, lichenological, soil studies;

August 11-20 - a traverse to the Bol'shaya Bootankagi river valley with geomorphological and lichenological studies;

August 14 - 24 - echo-sounding at the Levinson-Lessing Lake;

August 28 - September 1 - end of some activities, conservation and packing of the equipment and instruments;

September 2 - departure of the expedition participants to the Khatanga settlement.

The Labaz Lake region:

July 18 - a group of 9 people (3 Russians and 6 Germans) were delivered by MI-8 helicopter to the work site to the northern shore of the Labaz Lake.
July 22 - the profile for drilling an active layer (13 points) was set up;
July 23 - 30 - drilling of boreholes of the active layer;
July 31 - August 3 - geomorphological traverses to the west of the camp along the northern coast of the Labaz Lake, sampling from outcrops;
August 4 - 8 - geomorphological traverses in the vicinity of the camp;
August 9 - 10 - sampling from outcrop 2;
August 11 - 14 - drilling of the swell hillock in 2 km to the north-east of the camp;
August 17 - 18 - repeated drilling of some points of the geocryological profile;
August 21 - 22 - sampling from outcrops;
August 23 - 25 - temperature measurements along the profile of the active layer;
August 26 - September 1 - end of work, conservation and packing of the equipment and instruments;
September 2 - departure of the expedition participants to the Khatanga settlement by two MI-8 helicopters.

The Severnaya Zemlya pilot expedition

August 3 - a group of 9 people (1 Russian, 4 Germans, 4 Japanese) met in Norilsk.
August 4 - together with one more Russian, the group used a MI-8 flight to Labaz Lake and continued after a 4 hours' stop to Levinson Lessing Lake.
August 5 - 8 geomorphological, pedological and microbiological studies at Levinson-Lessing Lake
August 8 - flight with MI-8 helicopter to Prima Station (Cape Baranov) on Bol'shevik Island (Severnaya Zemlya Archipelago).
August 9 - 12 visit and preliminary studies of lakes on the three major island of the Severnaya Zemlya Archipelago. Preliminary pedological and microbiological studies.
August 13 - departure of the participants to Dickson by MI-8 helicopter.

The Logata river mouth region:

continuation of hydrological observations;
September 2 - departure of the participants of the third stage by MI-8 helicopter to the Khatanga settlement;
September 6 - a charter IL-18 flight by the air company "Mir" to St.Petersburg.

4 stage (September 9-October 23). It was conducted only in the region of the Levinson-Lessing Lake. All work was focussed on completing hydrological studies, the final phase of investigating the processes within soil, limnological studies and core sampling from permafrost.
September 9 - October 7 - continuation of studies of the preceding stages;
October 12 - 15 end of work, conservation of the camp, packing of the equipment and instruments, flight to Khatanga by MI-8 helicopter
October 23 - 26 - flight of the participants of the fourth stage from Khatanga via Norilsk to St.Petersburg.
November 28 - end of the expedition, delivery of all expedition equipment to St.Petersburg onboard an IL-76 aircraft.

2.2 Transport and radio communication

The delivery of the first team from St.Petersburg to the Khatanga settlement with most of the expedition equipment was by a charter IL-18 flight of the "Mir" company (Pushkin town). The activities of the first team took place during the cold season, hence, there was a possibility for using AN-2 aircraft on ski. Partly, during the first stage MI-8 helicopter were used. Transport operations directly in the work regions were conducted on foot and using a snow mobile "Buran".
At the second stage the group was delivered to the Khatanga settlement by a regular flight via Norilsk. Then to the work area - the mouth of Logata and Levinson-Lessing Lake the expedition participants were delivered by MI-8 helicopters. Right at the work site all transportation was on foot and by a snow mobile "Buran" as well as by rubber motor boats with 5 h.p. engines.
The delivery of the third team from St.Petersburg to the Khatanga settlement was by a special IL-18 flight of the "Mir" company. The expedition participants were delivered to the work areas by MI-8 helicopters. The return of the groups to the Khatanga settlement and St.Petersburg was by the same way. All transportation was on foot. For work on lakes and rivers, rubber boats of the NL-8 type were used.
Participants of the fourth stage were delivered to the Khatanga settlement by a charter IL-18 flight of the "Mir" company and then further to the Levinson-Lessing Lake by a MI-8 helicopter. Transportation in the lake area was by rubber boats and a snow mobile, as well as on foot. The return of the group to the Khatanga settlement was by MI-8 helicopter and from the Khatanga settlement to St.Petersburg by regular flights via Norilsk and Moscow.
There was stable radio communication during the work of all groups: with the AARI, AWI (Potsdam) using satellite and civil communication channels; with the Khatanga settlement and between field teams by means of radiostations of the type "Telefunken"; with field groups using a radiostation of the "Karat" type. The communication was regular - twice a day with an obligatory contact once a day. The main correspondent in Khatanga was the Hydrological Base and as an additional correspondent the "Taymyr" reserve. When necessary there was a possibility for communicating with the Russian geological expedition. During the work of the group at the Taymyr Lake there was regular communication with the meteorological "Taymyr Lake" station. As back-up stations, various polar stations were used.

2.3 Nature protection measures

The work at all stages of the expedition was performed with obligatory preventive nature protection measures. At all work stages all communal waste was collected into bags and sent to the Khatanga settlement, including metal drums from fuel. For refuelling stoves, generators and motors with liquid fuel special pumps which prevent fuel spills, were used. In periods with temperatures below-freezing point all transportation was made by a light snow mobile of "Buran" type with "Nansen" sledges or on foot. In the warm periods transportation was mainly on foot, for water activities rubber boats with suspended weak engines (5 h. p.), manufactured in Japan which prevent spills of oil products in water were used. Temporary camps of the expedition were carefully collected and no distinct traces which usually mark the human presence were left at the location sites.

3 PALEOGEOGRAPHICAL AND GEOMORPHOLOGICAL STUDIES (D. Bolshiyanov, G. Federov and O. Antonov)

3.1 The Relief and Quaternary Deposits of the Verkhnyaya Taymyra – Logata Area

A field exploration of the area of the Verkhnyaya Taymyra river (middle course) at the confluence of the latter with the Bolshaya Logata river was carried out from August 5 to 21, 1995, within the framework of the scientific project "Taymyr–95".

The purposes of the exploration were the development of a generalized section of the Quaternary deposits; the development of a map of the Quaternary deposits for part of the explored territory (scale 1:10 000); the description of the relief and the elaboration of a corresponding geomorphologic map.

Observation points (OP): 22; including outcrops and strippings: 9.

Number of samples: 103; including those intended for the EPR-test: 4;
for radiocarbon test: 3.

Border–lines of the area explored: North: the upper reaches of the Mamsere river; South: the northernmost externity of the Nerekhodya ridge; West: the southernmost externity of the Kolow (altitude mark 123,8 m); East: the eastern bank of Pestsovoye Lake.

The area has an extension of about 70 km from north to south and about 15 km from east to west.

The southern part of the area (to the south of Pestsovoye Lake) was most thoroughly explored.

The area lies in the northern part of the North Siberian Lowland: Its relief is characterized by vast terraces divided by sloping accumulative eminences with absolute altitudes of 90–100 m and peak heights up to 155 m (the Nerekhodya ridge). Typical for the district as a whole is its smooth totopography, apart from some of the sites at the Verkhnyaya Taymyra terraces.

Quaternary deposits

The oldest deposits at the surface within the area explored are upper Quaternary clays. Clay occurrences have been observed both in the north of the area (the hollow of Pestsovoye Lake; OP 2, Fig. 3-1)) and along the left bank of the Verkhnyaya Taymyra (3 km up-stream from the mouth of the Dalyokaya river; OP 11) as well as in its southern part (the upper reaches of the river Diring left tributary; OP 14). As a rule, the clays are compact, not stratified, with fragment and detritus jointing, the content of sand and aleurite fractions being 5–10%. Macrofauna (fragments and whole shells of pelecypodas) was discovered in two observation points, namely in the left upper reaches of the Diring river (shell detritus comprising over 10% of the total volume) and around the lake at the southernmost externity of Kolou ridge (altitude mark 123,8 m; OP 13). Scattered medium-rounded shingles (up to 10% of the total volume) were found in the clay mass around the mouth of the Dalyokaya river and the river Diring tributary. The visible thickness of the clay layer in OP 11 is up to 15 m. A clay layer roof was found at various absolute marks (see Table 3-1) and appears to outline the buried relief corresponding to the erosion grinding.

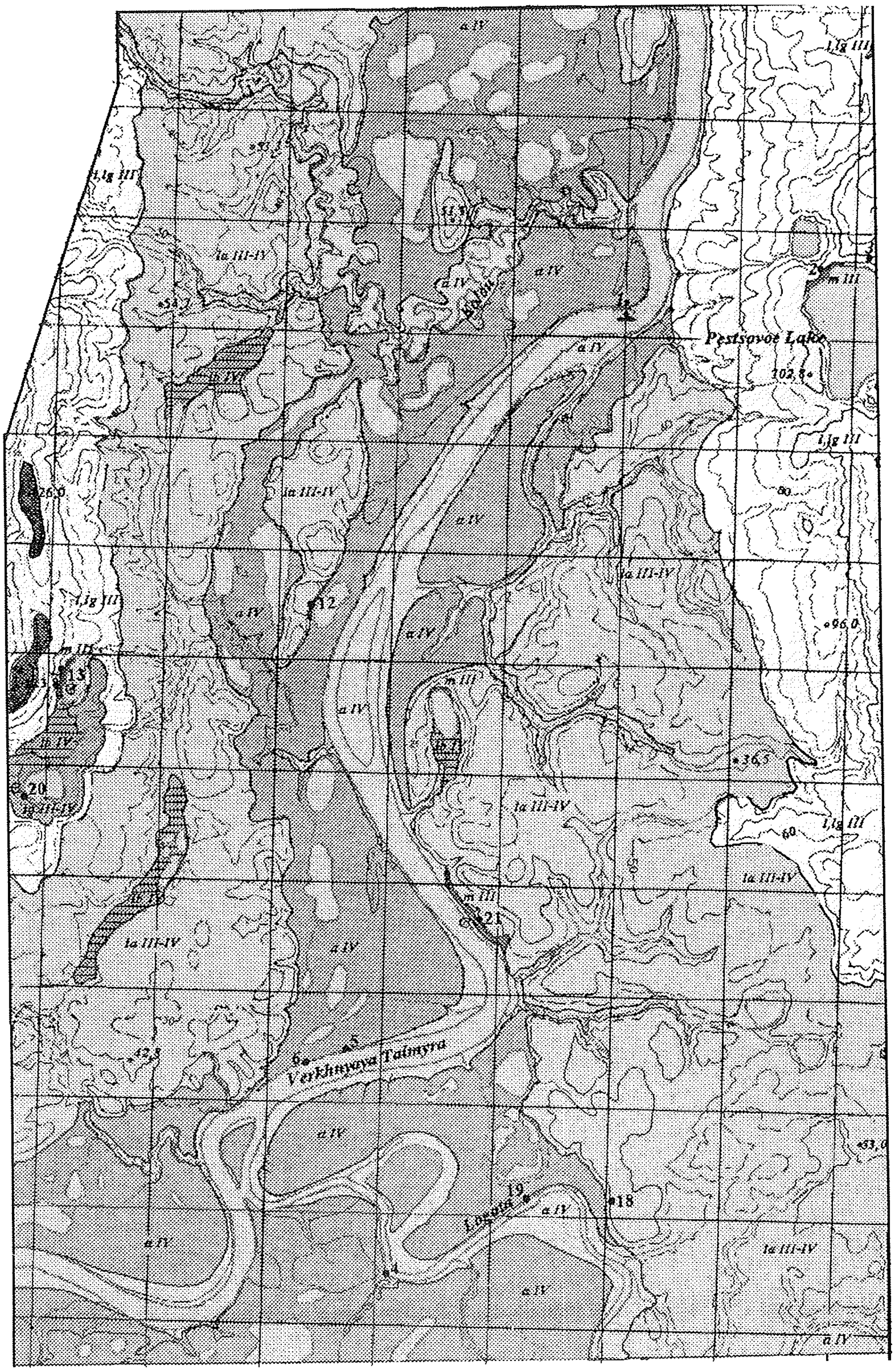


Fig. 3-1: Schematic map of Quaternary deposits of the Verkhnyaya Taymyra - Logata area

Legend to Fig. 3-1

Time			Genesis	Granulometric composition
QIII ?	QIII-IV ?	QIV		
			alluvial	sands , aleurite with peat lenss
			lacustrine	aleurite, dusty sands
			glacial	pebble- bouldery-sandy sedimets
			marine	clay with rare pebbles
			alluvial-lacustrine	dusty sands, silty aleurite
			lacustrine-glacial	gravel-pebble-sandy sediments
			lacustrine-marsh	aleurite,recent plant detritus

Findings of fossils:
- invertebrates
- vegetation

Bounderies of stratigraphic horizons:
- identified
- possible

•5 - points of observations

Table 3-1: Position of the clay roof

OP, No. (Fig. 3-1)	Location	Absolute mark of the clay roof
2	North-eastern bank of Pestsovoye Lake	91
11	3 km up the mouth of the Dalyokaya river (the left bank of the Verkhnyaya Taymyra river)	26
13	Southernmost externity of the Kolow mountain range (altitude mark 123,8m)	>70
14	Hill range along the left board of the river Diring's left tributary	75
21	Right bank of the Verkhnyaya Taymyra river, 6 km down from the mouth of the Logata river	18
22	Gully at the right slope of the Verkhnyaya Taymyra river, 7 km up the mouth of the Logata river	30

Similar clays were described in the lower part of the section on the right bank of the Logata river 4 km up the mouth of the Pestsovaya river.
Taking into account the considerable clay thickness and the character of the section as well as the presence of low salinity shellfish, the clay is regarded as marine, despite the absence of the characteristic stratification.
Clay is unconformably overlapped by sand and aleurite deposits, among which two types of section were defined. The first type is represented by fine grained and aleurite sands of the characteristic white–grey colour and lenticular stratification. The latter is frequently broken, bent or curved; numerous ferruginised interlayers, lenses and concretions, as well as intersecting pseudomorphs were found. No macrofauna was described in the section: A small number of thin interlayers of unsustained extension containing organic matter (redeposited) was observed. In the lower part of the section broken varve stratification (interlayers of grey clayey aleurite) can be noticed. In the vicinity of Pestsovoye Lake, deposits of this type constitute flat–topped hill ranges (relics of a kame terrace) with absolute marks 100–120 m, divided by numerous thermokarst lake hollows: On the northern bank of Pestsovoye Lake (OP 3) the visible thickness of the sands is 4,5 m. The sand layer deposition perhaps took place at one stage of the final retreat of the ice sheet in a cold–water circumglacial basin, with massifs of dead ice preserved.
The second type of sands are mostly fine grained to medium grained grey sands of indistinct horizontal stratification containing interlayers of well and medium rounded small–size shingle and poorly rounded large–size shingle. The average size of the pebbles (long axis) is 2,0–2,5 cm. This type of sands was found in OPs 15 and 17 in the upper reaches of the Diring left tributary and in the lake hollow at the northernmost externity of the Nerekhodya ridge. Deposits of slightly different composition have been described for the southernmost externity of the Kolow ridge around the altitude mark 123,8 m, where the following section (from top down) was described in the stripping on

the western bank of the lake:
1. Homogeneous grey fine grained sand. Lenticular and undulated stratification with interlayers (1–4 mm thick) of dark aleurite sand (to clay aleurite). At the bottom of the layer light dark–grey loam (1,5–2,0 cm) is observed..0,4 m.
2. Grey fine grained sand to aleurite sand in the lower part of the layer. Lenticular and undulated stratification oriented along the slope, with interlayers of dark–grey aleurite. Lenticular–undulate interstratification of aleurite and sand in the lower part of the layer; the rhythm thickness: 0,3-0,5 cm ....0,4 m.
Sharp uncomformable contact with numerous "pockets" containing a rusty-brown oxidation film and scattered fine shingle.
3. Light dark-grey clay of poor plasticity with indistinct stratification and detritus jointing, sandy in upper part. In the roof of the layer (20 cm) shingles (1,2-2,8 cm) are found, their rounding being 50–60%; the shingles comprise less than 20% of the total volume. Also scattered shell detritus and individual whole specimens of medium state of preservation are included............................0,3 m.

Several types of sections resulted from frequent climate oscillations, complexity and changeability of palaeogeographic situation in the time of sedimentation. Due to these factors the level of the basin did not remain stable: Therefore, sands were found at various absolute marks ranging from 70 to 105 m.
The formation of shingle–and–boulder and shingle–and–gravel deposits constitute the top surfaces of the Kolow and Nerekhodya ridges. Such deposits make up the characteristic inverted landforms, forming swells of 3–8 m high and 15–40 m long, with a slope angle up to 40°. The mechanical composition of these deposits in one of such swells (OP 16) is as follows:
large–size shingle - 45% of the total volume, rounding 30%;
small–size shingle (1,2–1,8 cm) – 15% of the total volume, rounding 60%;
poorly rounded boulders and blocks (up to 30 cm) – 20% of the total volume;
large–size and medium–size gravel – 10%;
silt (< 1 mm) – 10%.
Sizing is practically absent, isolated small–size shell detritus is found in a poor state of preservation.

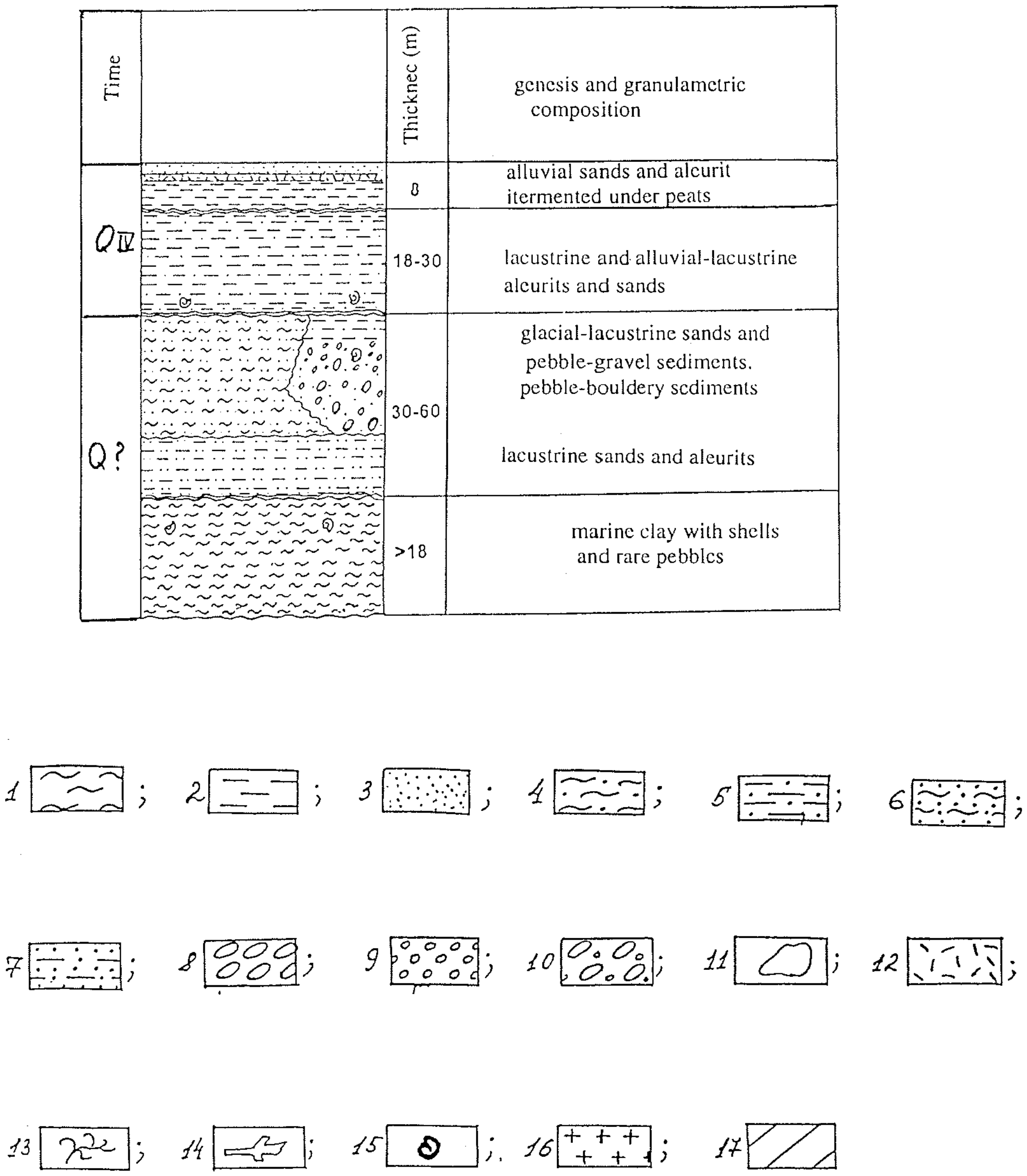
Similar deposits are regarded as ablation till, and the whole Nerekhodya ridge as a marginal structure of the Sartanian glaciation, the possibility of which is proved by buried glacier ice found in the central part of the range. But this question is still open.
Shingle and gravel deposits were met in a thermokarst lake hollow to the south–west of the 123,8 m mark in the Kolow ridge. These deposits constitute flat–topped swells (6–7 m high) of an asymmetrical profile along the southern and western banks of the lake, the swells being the relics of a local lake level terrace. The following section appeared in the stripping on the northern slope of the southern swell (from top down):
1. Small–size (1,0–1,5 cm) well– and medium–rounded shingle (30% of the total volume) with large– and medium–size gravel (40% of the total volume), as well as poorly rounded small–size boulders (< 20% of the total volume). Individual shell fragments in a poor state of preservation discovered..0,15 m.
2. Medium– and large–size shingle, mostly consolidated (5–7 cm), small–size boulders (rounding: 40%; 40% of the total volume); well–rounded small–size

shingle. The shingle long axes dip is usually directed north, north–east and east. Occasional shell detritus..0,10 m.
3. Shingle and gravel deposits with individual small–size boulders in the middle of the layer. Medium sizing. Shingle size: 0,8–1,2 cm to 2,5 cm; rounding: 60–80%. Medium–size well–rounded gravel comprising 20% of the total volume to 40% at the lower edge of the stripping..............................0,60 m.

Judging by the similar petrographic composition of the shingle, the glacial–limnic deposits of the swells were formed due to ablation moraine matter being washed away and redeposited by stream water. Deposits constituting terrace–like flat landforms on the south-eastern slope of the Mamsere ridge (OP 8), also found in one of the thermokarst lake hollows in the top zone of the range (OP 9), are of similar genesis. As no contact between the gravel–and–shingle and boulder– and–shingle deposits with underlying rock was found in any of the OPs, the problem of their exact age and genesis remains debatable.

Holocene deposits are represented by limnic and alluvial–limnic types, as well as by the alluvium of the first sub–floodland terrace (SFT 1) of the Logata and Verkhnyaya Taymyra rivers.
Alluvial–limnic deposits of the early Holocene form a terrace level at the absolute height of 40–50 m distinctly expressed in the lowland topography. All 40 m–level sections studied are characterised by similar litological composition. Given below as an example is the description of a section on the right bank of the Verkhnyaya Taymyra river, 6 km down the mouth of the Logata (OP 21; from top down):
1. Distinct horizontal and horizontal–undulated interstratification of light–grey fine grained sand to aleurite sand and dark–grey clayey aleurite. Rhythm thickness: 6–15 cm. The sand contains ferruginous interlayers and concretions up to 4 cm with rusty oxidation film. Visible thickness..0,65 m.
2. Yellow–grey sand aleurite, with distinct undulated and horizontal stratification marked by thin ochre interlayers and clayey aleurite lenses. The lower part of the layer contains the intercalation of horizontal strata of dark–grey clayey aleurite...0,20 m.
3. Grey aleurite of indistinct horizontal stratification with marked horizontally undulated interlayers of redeposited organic matter (up to 3 mm thick) and lenticular–like interlayering of light–grey aleurite sand..............................0,30 m.
4. Banded horizontal–undulated interstratification of dark–grey aleurite with clayey aleurite and yellow–grey aleurite sand. Rhythm thickness: 2–5 cm. Interlayers of rusty–brown oxidation film. Thickness..................................0,40 m.
5. Distinct horizontal–lenticular (large–rhythm in the lower part) interstratification of dark–grey clayey aleurite and light–grey sandy aleurite. Dip azimuth: 160°; angle 8°. An intercalation of light clay 15 cm thick in the middle of the layer. Rusty interlayers and concretions, along with scattered shell detritus all over the stratum; ferruginisation of the vertical and detritus jointing. Thin fresh–water bivalve shells in a good state of preservation (in situ) 0.55–0,65 cm from the roof ....0,90 m.
Distinct unconformable contact.
Medium–solid grey clay, practically not stratified; fragment and shell jointing and few fine well rounded gravel. Visible thickness ....0,40 m.
Judging by the altitude of the lower Holocene aleurite sole (18 m; OP 21), the section of alluvial–limnic deposits is up to 22 m thick, which enables us to suppose that a relatively large lake basin (the primo–Taymyr, up to 18 km

suppose that a relatively large lake basin (the primo–Taymyr, up to 18 km across) existed in the north of the lowland in the Holocene and sank later as a result of the river network change. A bench of the terrace level was formed in the wake of grinding.
Late Holocene deposits were stripped in the bench of the SFT 1 (6,5–8,0 m high; OP 15) and represented by flood–plain and river–bed alluvium facies. Peak visible thickness: 6 m. At the bottom of the section grey horizontally stratified aleurites are deposited, which are conformably overlapped by peat lenses up to 40 cm thick. The upper (major) part of the section is represented by yellow–grey sands (fine– and medium–grained) of horizontal or, less often, oblique bedding with interlayers of sandy aleurites of horizontal stratification.
The age and the origin of the described sediments will be determined only after a complex of laboratory investigations. At the moment we can show the cross section of the Quaternary deposits of the investigated region (Fig. 3-2).



1 - clay; 2 - aleurit; 3 - sand; 4 - sandy clay; 5 - sandy aleurit; 6 - silty sand; 7 - dusty sand;
8 - pebbles; 9 - gravel; 10 - pebble-gravel sediments; 11 - boulders; 12 - peat;
13 - plant detritus; 14 - ground wood; 15 - shells marine molluscs; 16 - ice; 17 - talus

Fig. 3-2: Cross section of Quaternary deposits for Verkhnaya Taymyra and Logata rivers area

3.2 Levinson Lessing Lake area

Quaternary geology and geomorphology studies in the Levinson-Lessing Lake area having continued the research work of 1993-1994, provided new data, definitely interesting for the area's palaeogeography reconstruction. The studies helped us to correct the geomorphologic map of the area scaled 1:100000 that had been composed earlier (see Fig. 3-3). Samples taken from the newly found and described outcrops allow datings and other assays.

The discovery of till-comprising ice in the river Zamknutaya valley is considered most interesting. Other described objects were located mainly in Bolshaya Bootankaga, Krasnaya, Ledyanaya river valleys. During the field routes there was also taken water from the gullies for pH and electric conductance analysis. Water sampling points, along with the routes traces and the points of geologic observations, are shown at the data distribution map (see Fig.3-4).

The river Zamknutaya is the first size tributary of the largest river of the Levinson-Lessing basin, the Krasnaya river. Zamknutaya occupies a valley formed by a number of various geomorphologic processes of the ancient hydrographic network. Zamknutaya valley is 12 km long, about 2 km wide, and almost 300 m grinded. It seems a pure trough in the cross-section and is longitudinally oriented.

Till-comprising 10.5 m thick ice outcrops at the right side of the valley in 2.5 km from the river mouth in a thermokarst depression about 200 m in diameter. GPS co-ordinates: 74°36'53" north, 98°32'29" east. Ice is overlain by 0.5 m thick till (boulders and pebbles blend). Besides the described contemporary thermokarst depression with the ice wall outcropping, there were discovered some other landforms that may have been created by the same ice melting process in the circumference of approximately 1 km, suggesting a considerable ice body, with hardly identified present margins. The observed ice wall height of 10.5 m and the altitude difference of about 10 m between the wall bottom and the river level lead us to the total ice thickness estimation of 20 m. Ice must achieve the water level judging by the meltwater discharge.

Outcropping ice represents two blocks with the till strata rubbed in between (pebbles, boulders, gravel, and loam intermixed). Blocks and layers have the general inclination about 15° south, that may indicate the ice movement direction northward.

Numerous are the inclusions of the same till material in the ice. The latter is stratified, in the lower part especially. The average layers thickness is 20 cm.

The associated terminal moraine is distinctly contoured upslope. Due to the enumerated evidences we consider the described ice a glacier.

The ice was sampled for oxygen isotope analyses. Inside the thermokarst depression there is a 4 meters high fan of stepped morphology reflecting both the evolution stages of the fan and of the mother depression. Despite the fan deposits thickness, the present stream (about 1 km long and 15° inclined) is negligible.

Furthermore, in the same depression there are some other bodies described, the top surface of which is levelled, though the bedding cannot be considered normal. Sandy, sandy-loamy, and loamy organic- and rock clasts-rich icy material groups into layers and lenses often thrown backward. These deposits have been sampled for palinologic analysis.

The field data and the 1:50 000 scaled aerial photographs decipherment allowed us to compose the principal geomorphologic scheme of the same scale for the river Zamknutaya valley segment (see Fig. 3-5).

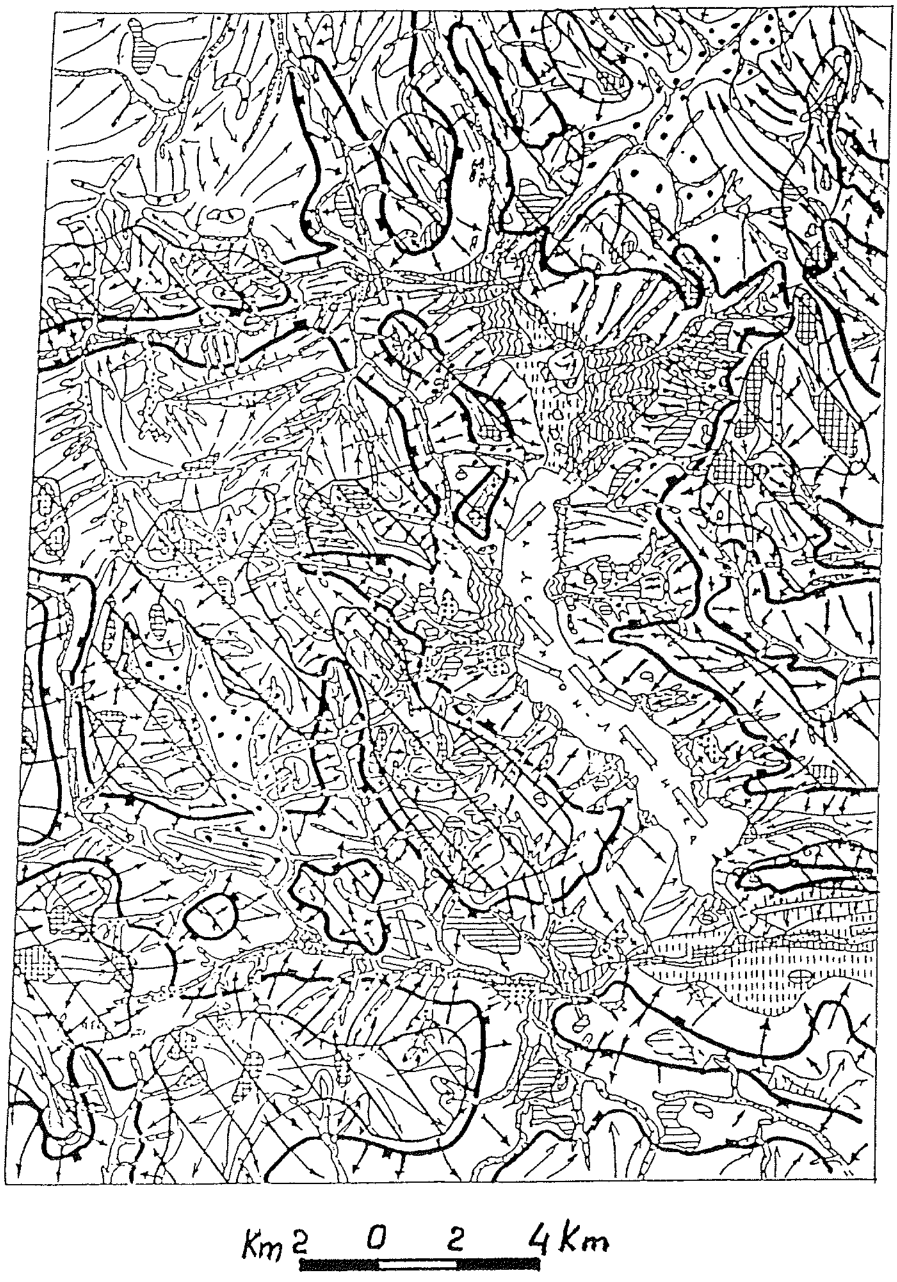
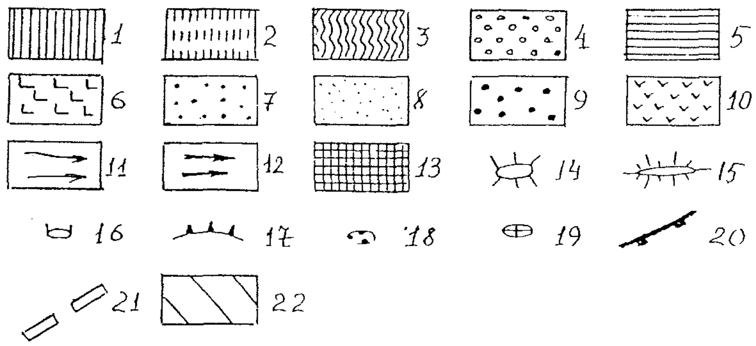


Fig. 3-3: Geomorphical map of Levinson-Lessing Lake area

Legend to Fig. 3-3:



Accumulative relief:
1 - Holocene foodplain; 2 - first Holocene terrace; 3 - Holocene alluvial-proluvial fans

Accumulative-abrasion relief:
4 - Late Pleistocene marine terrace platforms 90-100m in height; 5 - Prelate Pleistocene marine terrace platforms 155-250m in height; 6 - probably Prelate Pleistocene marine terrce platforms over 300m in height;

Erosional relief:
7 - Late Pleistocene valleys without terraces varved on depths to 60m; 8 - recent bottom of Late Pleistocene cuts; 9 - Late Pleistocene gently erosional terrace platforms to 20 m (above water level);

Denudational relief:
11 - eluvial-solifluai slopes os steepness 1-3 degrees; 12 - solifluai and debris slopes of steepness over 3 degrees; 13 - Prepleistocene (?) surface of levelling platforms;

Landforms:
14 - erosional relic; 15 - structural-denudational ridge; 16 - high erosional terrace of 9m (above water level); 17 - lake terraces of 2, 4, 7 m height; 18 - thermocarctic lows; 19 - mound of swelling

Others:
20 - ancient Prepleistocene valley complex denudation edge; 21 - supposed Earth's crust faults axes; 22 - supposed sites of the Last Glaciation ice bodies

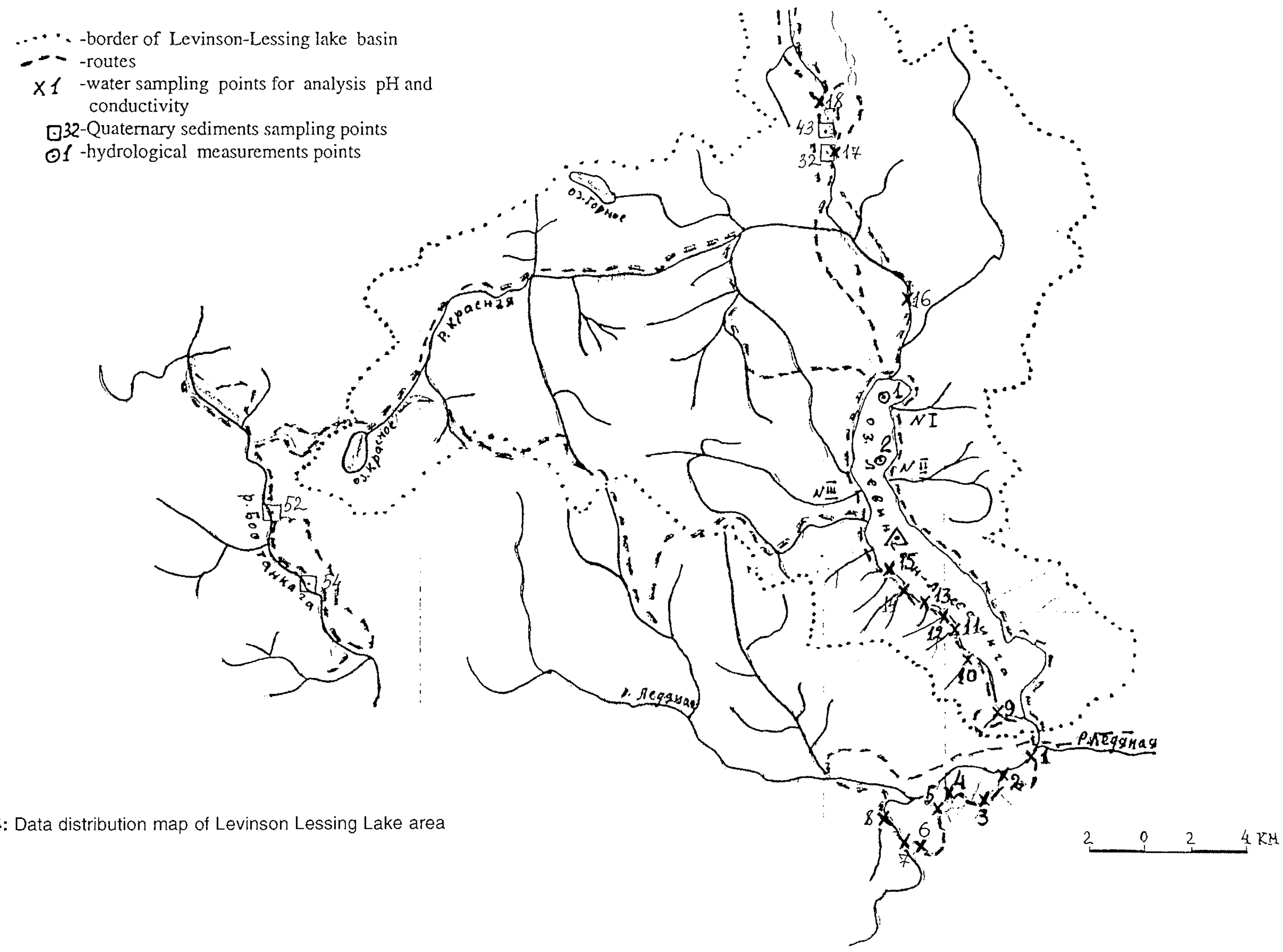
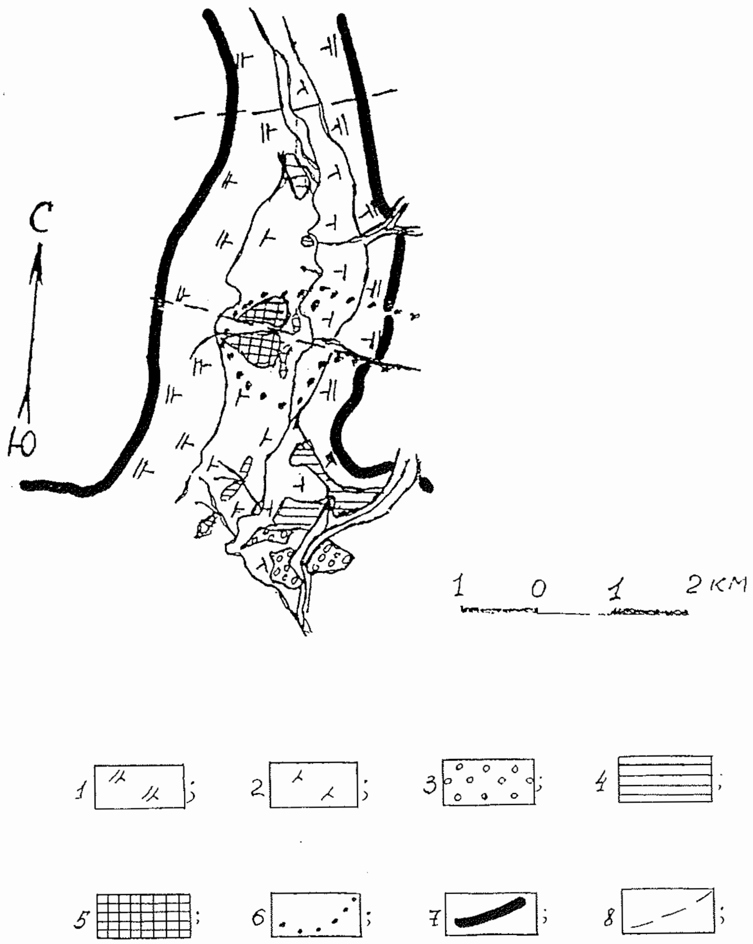


Fig. 3-4: Data distribution map of Levinson Lessing Lake area



Legend:

1 - slope of steepness to 35 degrees; 2 - slope of steepness to 10 degrees; 4 - high erosional terrace platforms to 20m (above water level); 5 - end-moraine formation;
6 - supposed boundaries of the ice tongue; 7 - edge of river Zamknutaya valley;
8 - intrusive development expressed in relief

Fig. 3-5: Geomorphological schematic map of river Zamknutaya valley part

The preliminary consideration of the obtained material makes us suggest the local spreading of the glaciation that has left the described ice body and syngenetic till, including the terminal moraine deposits, and detect the glaciation margins within the studied area.
Because of the impossibility to cover the whole map sheet area with the observations during the field season of 1994, the composed Levinson-Lessing Lake basin geomorphologic map had to be rather schematic in the localities uncovered with the field routes and mapped on the base of aerial photographs scaled 1:50 000.
The season of 1995 enlarged the routes network and the data amount. Morphology and genesis of some landforms have been corrected.
First, there was corrected the Zamknutaya valley. Beside the terminal moraine, the highest (20 m above river level) terrace was traced throughout the studied part of the valley and mapped. Two outliers of this terrace exist in the river Krasnaya valley. By previous data, they were classified as marine terrace. The outliers correlate with the concave bend at the Krasnaya valley cross-section, marking the former presence of the same terrace in this valley.
Then, in the southern part of the area we have traced the top surface 160 m above sea level, shown at the map as the marine terrace.
Besides, the map has been supplied with the latest glaciation ice bodies hypothetic margins, and a number of small additions and corrections.
Bolshaya Bootankaga river is Niznyaya Taymyra northern (left) tributary. The river basin borders upon Levinson-Lessing Lake basin from the West. The area in the middle stream was studied.
The valley width here does not exceed 4 km. The cross-section is U-like (trough-like), orientation is longitudinally.
The valley and its tributaries morphology reveals the several stages of grinding history. The youngest tributaries are the hanging canyons, and their debris fans often overlay the highest cyclic terrace.
The river has flood-lands and the high flood-lands of 2-3 m height throughout the whole studied area. The fragments of another terrace, up to 6 m in height, are widely spread, but usually obscured by the superimposed fans. Also notable are the 10 meters terrace fragment and the 25 meters terrace fragment with a thin, less than 1 m, alluvial layer on top. The exact age relations of all terraces will be revealed after the analytical investigations of the sampled deposits.

Besides a route survey of geomorphology and Quaternary sediments, recent landforming processes observations were carried out. The measurements were carried out on two profiles of solifluction rate monitoring, set up in 1994. Through all profile lengths there are yellow stones on equal distances. Measurements on both profiles were carried out at the same time with an interval of about 10 days.

Profile No.1:
The northern slope of Lake Levinson Lessing is 750m from the mouth of the river Krasnaya and 300m from the lake coast. The orientation is NNE, zero reading north-eastern end. The angle of the slope is 6 degrees. Two supports are buried into excavations of 60cm within the active layer of 40-45 cm. The length of the porofile is 14.9m, stones are set every 25cm, total 58 stones.

Profile 2:
The northern slope of Lake Levinson Lessing is 750m from the mouth of the river Krasnaya and 150m from the lake coast. The orientation is NNE, zero reading north-eastern end. The angle of the slope is 2 degrees. Two supports are buried into shallow holes of 1.2m within the active layer of 35cm. The length is 24m, stones are set every 25cm, total 94 stones. Between the supports by turnbuckle a wire is tightened and relative to these wires the yellow stones' movement is measured. The size of the stones is 7-10cm. The first determination was executed at 13.06, the last at 15.09. Fig. 3-6 demonstrates the graphic pattern of this test for profile No. 2. It is evident that the stones are transferred along the downward slope in the southern part and upwards in ther northern part of the profile. In addition, according to the rest determinations, stones' movements have the character of oscillations (up-down along the slope). The comparison with patterns of mean daily temperatures shows a close relationship: During the substantial warming stones move up on the slope, whereas during the cooling quite the reverse happens. The regularity in the movement of the same stones and its close relationship with temperature patterns allows the statement that the obtained results are true. For analysis of this phenomenon one needs more data on the soil temperature and soil water patterns.

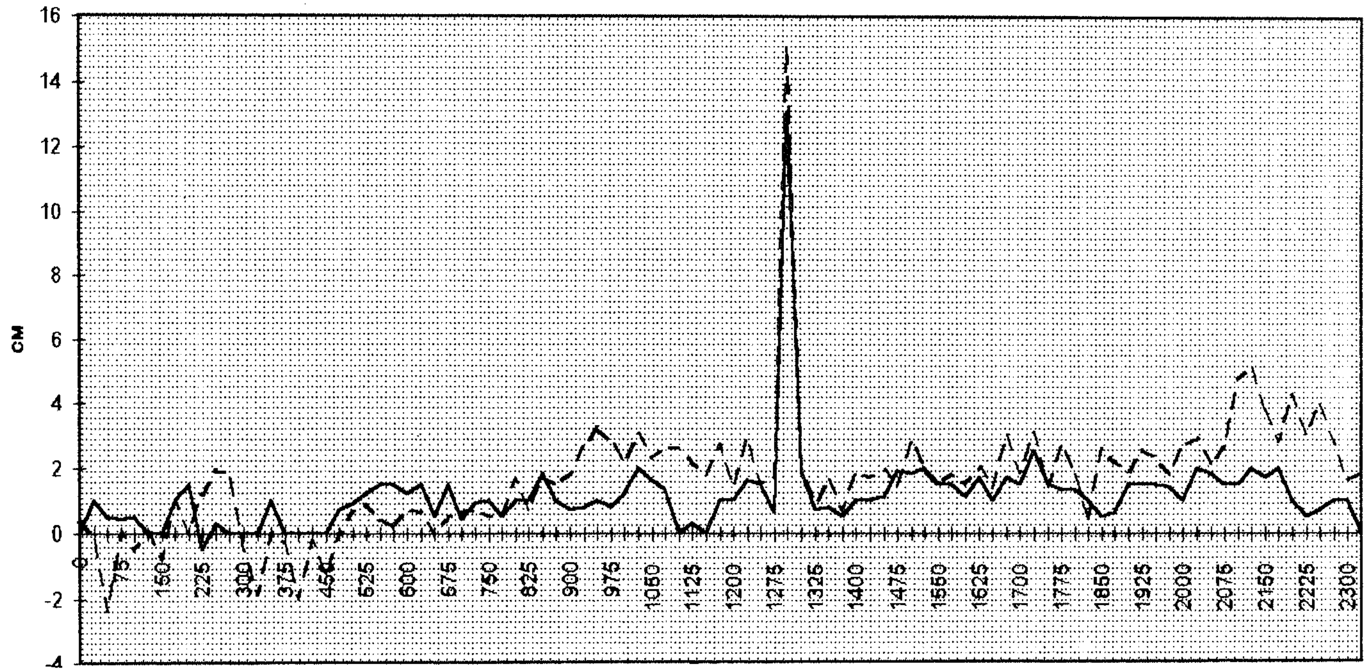


Fig. 3-6: Solifluction profile No. 2

Position of marked stones:
13.06.
15.09.

4 GEOCRYOLOGICAL AND PALEOGEOGRAPHICAL STUDIES IN THE LABAZ LAKE AREA

(C. Siegert, A. Derevyagin and G. Vannahme)

4.1 Introduction

Controversial ideas regarding the extent and age of the last glaciation in Western and Central Siberia are currently under discussion. The solution to this problem is very important, as it would affect the character of the atmospheric circulation model during the Late Pleistocene. Data on the development of permafrost at the eastern border of the glaciated territory can contribute to solve this problem.

The Labaz Lake depression in the eastern part of the Taymyr Lowland is a typical location of flat tundra regions. In case of accepting the variant of maximum ice sheet extent during the Sartan (Late Weichselian) glacial period in Siberia, the Labaz Lake area might be part of the marginal zone (Velichko et al., 1993). This territory, therefore, is most promising to paleogeographical study.

Results obtained during the field work in 1994 permit to construct a general geological section of the Labaz Lake depression. Several Late Quaternary stages of sedimentation under permafrost conditions are proven. The evolution of permafrost is closely connected with the development of sedimentary processes. Each stage corresponds to morphostratigraphical complexes of sediments formed by glaciolacustrine, glaciofluvial, lacustrine, fluviolacustrine, fluvial, nival or aeolian processes. Radiocarbon ages between 43.900 and > 47 000 years B. P. of syngenetic permafrost with thick ice-wedges, as well as additional data provide evidence that since the beginning of the Karginsk interstadial period geomorphologic processes formed this region under permafrost conditions. No evidence was found that the Labaz area was glaciated during the Sartan period (Siegert et al., 1995).

Based on our already obtained results the main task of the field work in 1995 was to continue the investigation of the Late Quaternary environmental history of the Labaz Lake area using geocryological and other paleogeographical methods. The character of recent geocryological processes should be studied by measuring ground temperatures in bore holes and determining the active layer thickness of different study sites along a typical transect. The expected data should help to elucidate the relationship between landscape conditions and temperature distribution in permafrost. Study of the upper permafrost horizon along this transect by the use of geocryological, geochemical and other methods will contribute to the understanding of permafrost reactions on changing climate in the Holocene. The relationship between recent morphological forms and geocryological conditions as well as the genesis of Late Quaternary sediments were investigated by means of geomorphologic mapping of permafrost landscapes.

4.2 Paleogeographical studies on permafrost sequences

During the field season in 1995 our work focused on the study of permafrost sediments which have been formed in the Karginsk (Middle Weichselian) and Sartan (Late Weichselian) periods. In addition, the investigation of Zyryansk (Early Weichselian) and Holocene deposits from 1994 were continued and expanded. A sum of 19 outcrops and 2 excavated holes (Tab. 4.2-1) with ancient permafrost sediments were investigated. Most study sites are located on the steep escarpment of the northern Labaz Lake shore. In addition, investigations were carried out on the western shore of Labaz Lake, Labaz Kholma Shore, Kokora Lake, and to the valley of Tolton-Pastakh-Yurakh river (Figs. 4.2-1, 4.2-2 and 4.2-3).

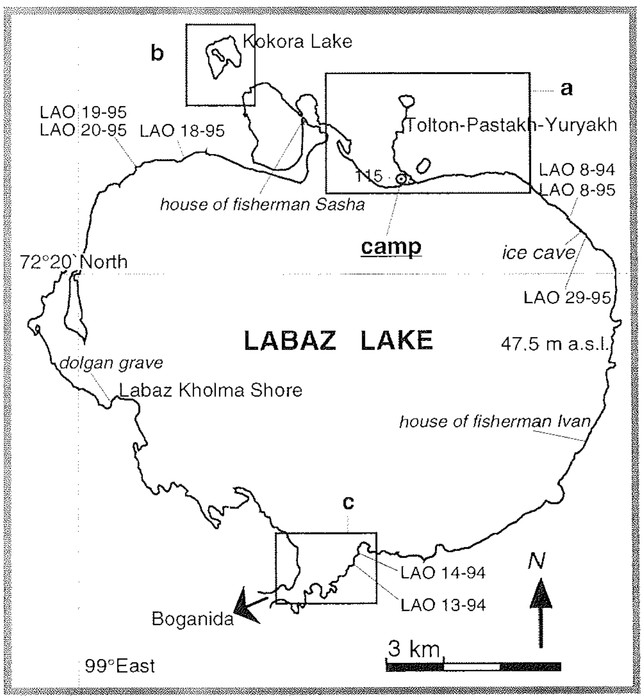


Fig. 4.2-1: Overview map of the Labaz Lake study area

a - Tolton-Pastakh-Yuryakh key section (see Fig. 4.2-2)
b - Kokora Lake section (see Fig. 4.2-3)
c - Boganida section;
LAO - outcrop and its number

Table 4.2-1: List of permafrost profiles investigated in outcropes, Labaz Lake area

Site	Position		Thicknees	Type of samples					
no.	Latitude	Longitude	[m]	LiA	MiA	ChA	IsA	RaCD	PoA
LAO 1-95	72°22.8'N	99°45.9'E	2,0			x		x	x
LAO 6-95	72°23.4'N	99°42.9'E	4,0	x	x	x	x	x	x
LAO 8-95	72°22.0'N	99°55.9'E	3,0	x	x	x	x		
LAO 15-95	72°22.8'N	99°49.8'E	12,0	x	x	x	x		x
LAO 18-95	72°23.5'N	99°22.3'E	2,0	x	x	x	x	x	
LAO 19-95	72°23.2'N	99°16.8'E	3,0				x		
LAO 20-95	72°23.2'N	99°16.8'E	2,5	x	x	x	x		
LAO 21-95	72°22.9'E	99°51.7'E	1,4					x	
LAO 22-95	72°22.6'E	99°42.2'E	7,5	x	x	x		x	x
LAO 23-95	72°22.8'N	99°49.8'E	1,8	x	x	x			
LAO 24-95	72°22.8'N	99°46.4'E	16,0	x	x	x	x	x	
LAO 25-95	72°22.7'N	99°44.5'E	5,0	x	x	x		x	x
LAO 26-95	72°25.7'N	99°24.0'E	10,0					x	
LAO 27-95	72°25.6'N	99°23.8'E	5,0					x	
LAO 28-95	72°25.8'N	99°24.3'E	15,0	x	x	x			x
LAO 29-95	72°21.7'N	100°2.2'E	15,0-20,0				x	x	
LAO 30-95	72°23.4'N	99°40.9'E	1,5					x	
LAO 31-95	72°23.5'N	99°41.1'E	2,7	x	x	x		x	
LAO 33-95	72°23.8'N	99°34.7'E	3,5					x	

LiA – lithological analysis: granulometry, grain shape, grain surface condition;
MiA – mineralogical composition, especially new formed minerals;
ChA – chemical composition;
IsA – isotopic composition of ground ice;
RaCD – radiocarbon dating;
PoA – pollen analysis.

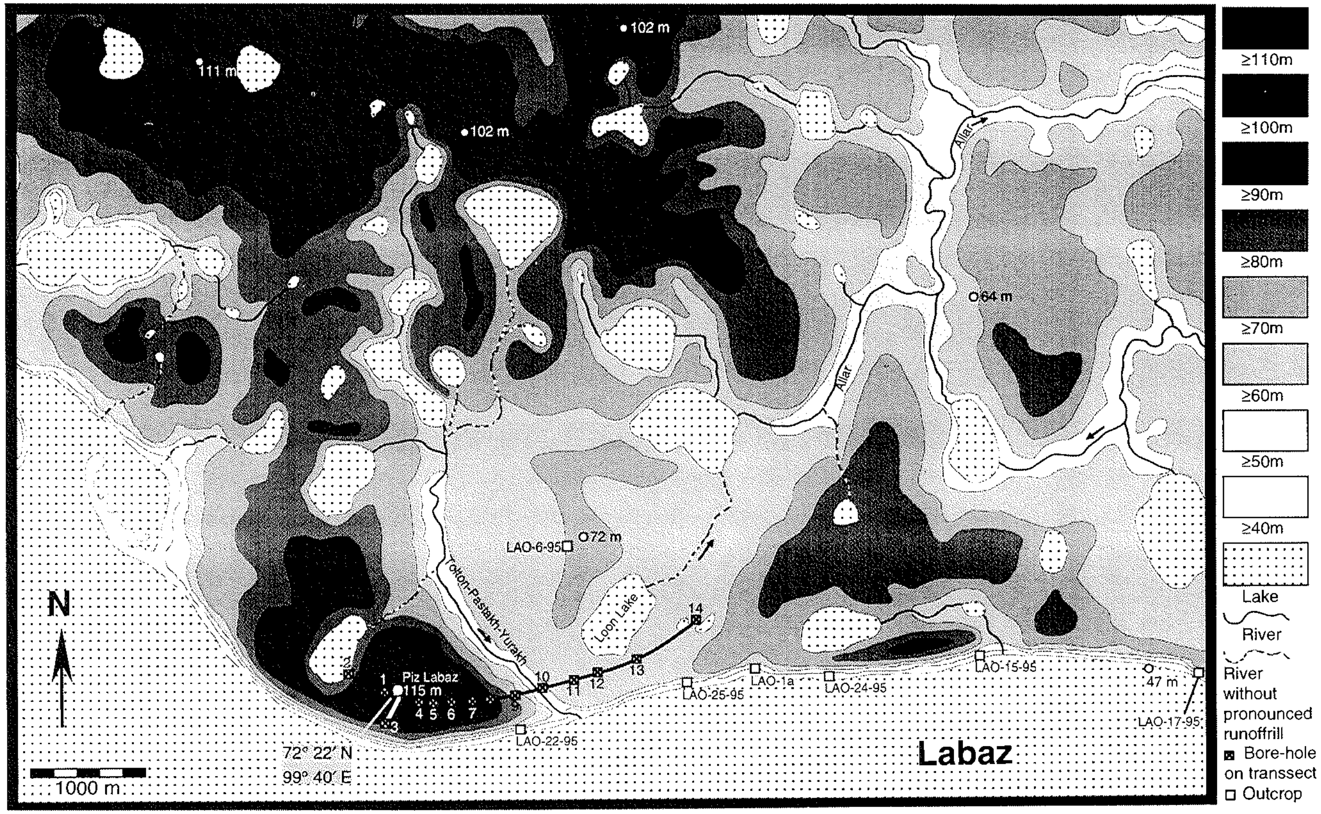


Fig. 4.2-2: Topographic sketch of the Tolton-Pastakh-Yurakh key section with location of the study sites in 1995

The *frozen ground facial analysis* was used as the basic method for geocryological investigations of permafrost sequences in the field. This method is based on the relationship between the cryogenic construction of sediments and the permafrost landscape conditions at the time of sediment freezing (Katasonov, 1973, 1978). At all study sites samples were taken for analytical investigations including radiocarbon dating, lithological, mineralogical, geochemical and ground ice isotope analysis. A combination of frozen ground facial analysis with the interpretation of analytical data provide a possibility to reconstruct the paleoenvironmental development of the area. Information on type and number of samples taken from the study sites have been compiled in Table 4.2-1.

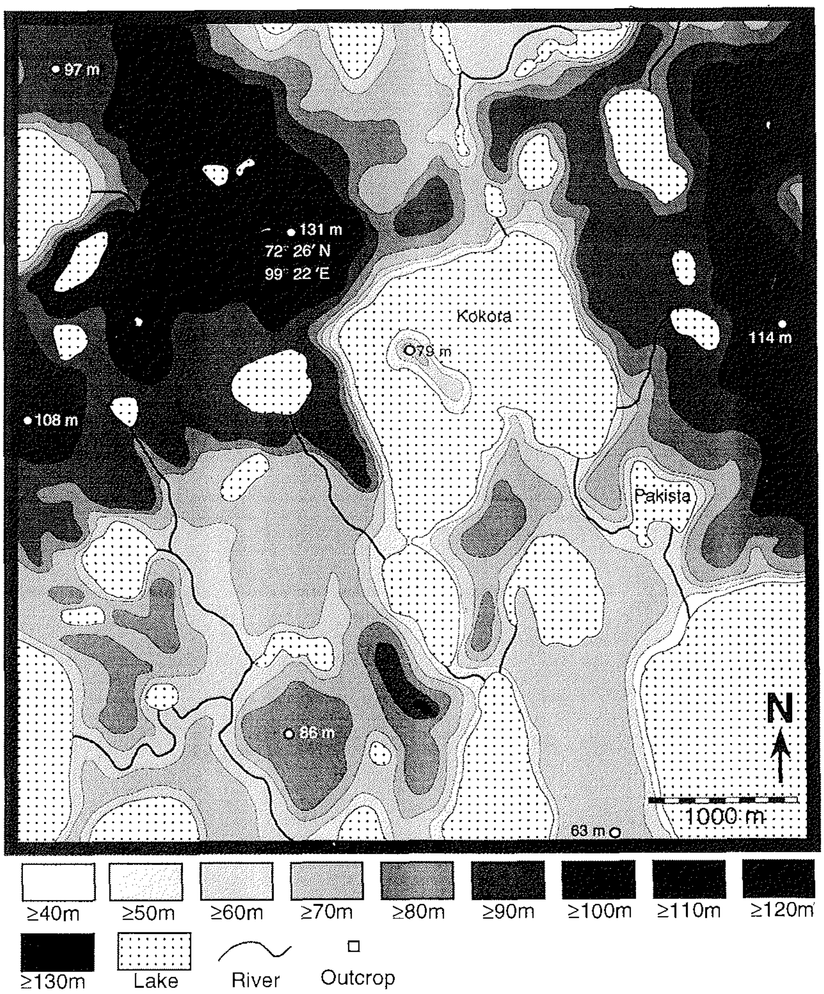


Fig. 4.2-3: Topographic sketch of the Kokora Lake section with location of the study sites in 1995

Field studies carried out in summer 1995 show that the Karginsk sedimentary complex consists of certain cycles of lacustrine and fluviolacustrine accumulation. Clay and silt horizons alternate with sand and peat layers. Sedimentary features and cryogenic structures of Karginsk permafrost complexe indicate that accumulation and freezing of sediments have taken place in shallow lake basins. From time to time an unstable hydrological regime led to freezing of lake sediments. Very ice-rich permafrost with characteristic lattice-like cryogenic structures including small ice wedges has been formed (Fig. 4.2-4). Most probably the variation of sedimentation and freezing conditions is caused by changing climate and changing hydrological conditions. At the most important study sites (LAO 1-95, LAO 6-95, LAO 22-95, LAO 25-95), samples were taken in detail for analytical investigation including radiocarbon dating, lithological, mineralogical, geochemical and ground ice isotope analysis (Tab. 4.2-1). In addition, a subaerial syngenetic permafrost complex with polygonal ice-wedge systems was sampled.

Fig. 4.2-4: Rhythmically layered Karginsk subaquatic sediments with a small ice wedge (on the right), lattice-like cryostructure of the clayey-silty horizons;
outcrop LAO 22-95

Sediments probably formed during the Sartan glacial period, have a limited distribution in the Labaz Lake area. They consist of sand without organic remains and include thick ice-wedges polygons. Such kind of deposits are found at the western shore of Labaz Lake, perhaps at the shore of Kokora Lake and isolated in river valleys. A lot of rounded frosted grains in Sartan sediments indicate a strong influence of eolian transport. The stratigraphic classification is based only on the geomorphologic position and the special cryolithological features. The latter points to cold-arid climatic conditions during sediment formation. It is planned to use thermoluminescence methods for the absolute dating of these sediments.

4.3 Climatic influence on geocryological and sedimentary processes

In order to study the effect of climate change during the Holocene on sedimentary and geocryological processes in the lowland tundra a transect along the northern shore of Labaz Lake was investigated by core drilling (Figs. 4.2-2 and 4.3-1). Altogether 18 holes were drilled, varying in depth from 1 to 7 meters in dependence on the geocryological conditions. The transect characterizes the 10 most widespread landscapes in the northern part of the Labaz Lake area: lake terraces, lake depressions, peatlands, polygons, different types of solifluction slopes, flood planes, watershed surfaces with eolian removal of thin particles, and pingos in depressions with isolated remnant lakes.

The core profiles were investigated in detail by frozen ground facial analysis. Samples were taken for lithological, geochemical, mineralogical and isotope analysis. At some profiles, additional samples were taken for pollen analysis and radiocarbon datings (Table 4.3-1). The expected results should provide a possibility to obtain data on geological and cryogenic construction for the upper part of Zyryansk and Karginsk sediments and on their transformation during the Holocene.

The results of field studies show, that in all study sites the uppermost horizon of permafrost differs from the underlying old permafrost. As a rule, the upper horizon consists of ice-rich soil layers with a special cryogenic structure (Fig. 4.3-2). Usually, a layer with the highest ice content (ice-soil) is located at the depth of about 1-1,5 m. It can be assumed that at all sites the cryogenic construction of the upper layer has been formed by an increase of active layer depth during a long-term climate warming and subsequent freezing up. The ice-soil between 1-1,5 m points to a longer stagnation of the active layer boundary. The transformed ancient active layer has the greatest thickness in shallow depressions at the Karginsk Lake terrace (LAB 9-95, LAB 11-95, LAB 12-95, Fig. 4.3-1).The cryogenic structure and the elevated conductivity of ground ice indicates that small thermokarst depressions with shallow lakes or lake-mires existed here during the Holocene (Fig. 4.3-3). At other sites this ice-rich layer is significantly smaller, due to erosion processes and suprapermafrost water run off preventing the formation of a greater thickness (LAB 5-95, LAB 6-95). The ice-rich upper horizon corresponds to the *Intermediate Layer* described in detail by Shure (1988).

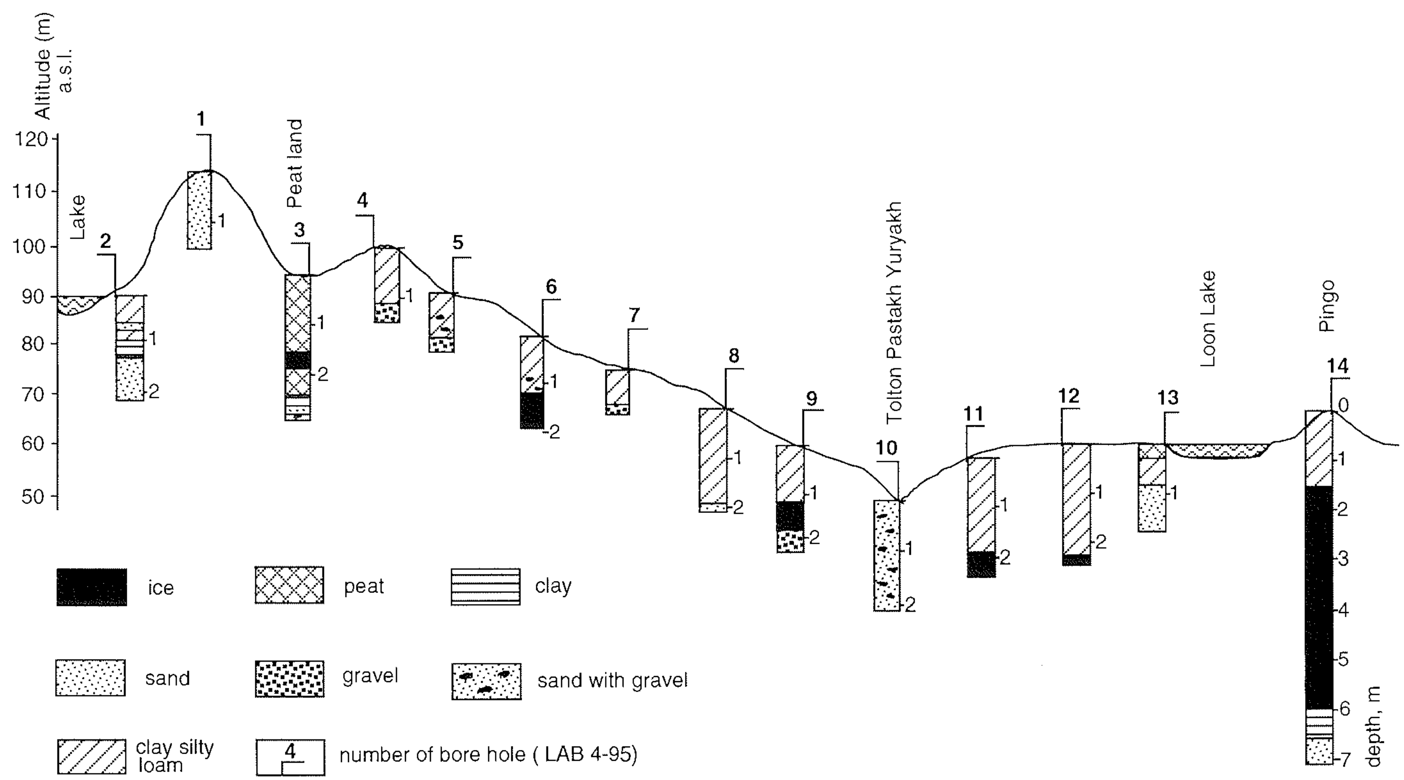
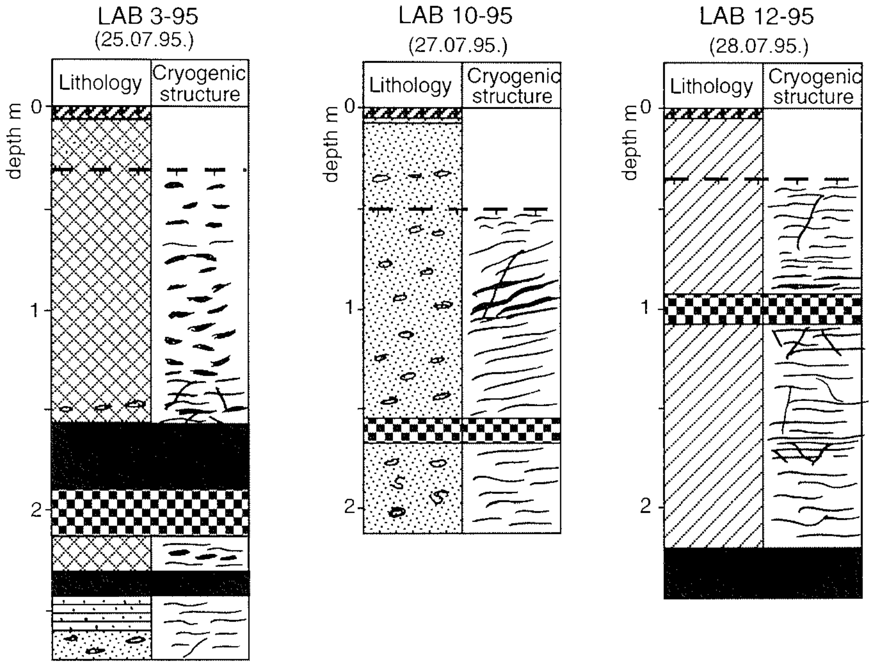


Fig. 4.3-1: Schematic drilling transect at the northern shore of Labaz Lake (LAB 1-95 -- LAB 14-95); for position see Fig. 4.2-2

Table 4.3-1: List of permafrost profiles investigated by core drilling in the Labaz Lake area

Site no.	Position		Drilling depth [m]	Type of samples					
	Latitude	Longitude		LiA	MiA	ChA	IsA	RaCD	PoA
LAB 1-95	72°22.8' N	99°49.6' E	1,25	x	x	x			
LAB 2-95	72°22.9' N	99°51.7' E	2,00	x	x	x	x	x	x
LAB 3-95	72°22.6' N	99°46.1' E	2,70	x	x	x	x	x	x
LAB 4-95	72°22.6' N	99°40.3' E	1,05	x	x	x	x		
LAB 5-95	72°22.7' N	99°40.7' E	0,90	x	x	x	x		
LAB 6-95	72°22.7' N	99°40.9' E	1,90	x	x	x	x		
LAB 7-95	72°22.7' N	99°41.4' E	0,70	x	x	x	x		
LAB 8-95	72°22.6' N	99°41.9' E	2,05	x	x	x	x		
LAB 9-95	72°22.6' N	99°42.5' E	0,85	x	x	x	x		
LAB 9/2-95	72°22.6' N	99°42.5' E	1,80	x	x	x	x		
LAB 9/3-95	72°22.6' N	99°42.5' E	2,35			x	x		
LAB 10-95	72°22.7' N	99°42.8' E	2,20	x	x	x	x		
LAB 11-95	72°22.7' N	99°43.1' E	2,10	x	x	x	x		
LAB 11/2-95	72°22.7' N	99°43.1' E	2,15			x	x		
LAB 12-95	72°22.9' N	99°43.4' E	2,40	x	x	x	x	x	
LAB 12/2-95	72°22.9' N	99°43.4' E	2,10			x	x		
LAB 13-95	72°22.9' N	99°43.7' E	1,75	x	x	x	x	x	
LAB 14-95	72°23.1' N	99°45.1' E	7,05	x	x	x	x	x	x

LiA – lithological analysis: granulometry, grain shape, grain surface condition;
MiA – mineralogical composition, especially new formed minerals;
ChA – chemical composition;
IsA – isotopic composition of ground ice;
RaCD – radiocarbon dating;
PoA – pollen analysis.



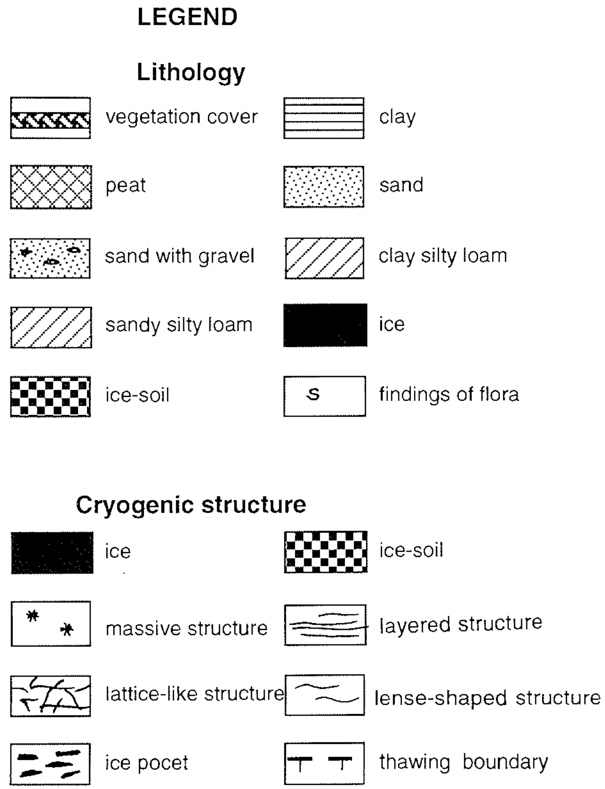


Fig. 4.3-3: Typical cryolithological profiles of the northern shore zone of Labaz Lake (for position see Figs. 4.2-2 and 4.3-1)

Regular (every 10 day) measurements of the seasonal thawing depth have been carried out at all study sites along the drilling transect. The results are presented in Table 4.3-2.

Table 4.3-2: Seasonal thawing depth at the drilling transect, northern shore of the Labaz Lake

Study site	Thawing depth [m]			Character of surface
	21.07.1995	08.08.1995	22.08.1995	
1 (LAB 1-95)	0.89	0.95	>1.0	Dry watershed surface with rare moss and lichen
2 (LAB 2-95)	0.41	0.50	0.60	Lake depression; moss, lichen, meadow
3 (LAB 3-95)	0.30	0.40	0.45	Peatland with high-centre polygons; moss, meadow
4 (LAB 4-95)	0.70	0.72	0.75	Watershed surface with polygons; moss, lichen, meadow
5 (LAB 5-95)	0.30	0.55	0.65	Flat terrace surface; moss, meadow
6 (LAB 6-95)	0.47	0.53	0.60	Solifluction slope; moss, meadow
7 (LAB 7-95)	0.52	0.56	0.58	Flat terrace surface; moss, meadow
8 (LAB 8-95)	0.30	0.45	0.52	Humid flat solifluction slope; moss, meadow
9 (LAB 9-95)	0.53	0.60	0.62	Flat terrace surface; moss, meadow
10 (LAB 10-95)	0.50	0.55	0.60	Flood plain; moss, meadow
11 (LAB 11-95)	0.35	0.45	0.45	Flat terrace surface; moss, meadow
12 (LAB 12-95)	0.35	0.40	0.45	Flat terrace surface; moss, meadow
13 (LAB 13-95)	0.30	0.40	0.40	Lake depression; moss, meadow, shrubs

4.4 Ground temperature measurements

The recent ground temperature distribution is an essential characteristic of permafrost, providing different information on past environmental conditions of an area (Kondrateva et al., 1993). So far, no data on the temperature in permafrost of the large lake depressions in the eastern Taymyr Lowland are available. Therefore, results of temperature measurements in the Labaz Lake area are of great interest.

The ground temperatures were determined in three shallow bore holes by the use of a thermistor string (ESYS GmbH, Berlin). The results permit to characterize the influence of microclimatic factors on the temperature distribution in permafrost.

The bore holes LAB 1-94 and LAB 2-94 are located in peatlands of different age in a flat fluviolacustrine depression. Hole LAB 1-94 was drilled on the dry surface of a terrace outlet at the Tolton-Pastakh-Yurakh river valley. Dry peat-soil cover and a ground ice content of just 40-50 % (gravimetric) in the permafrost lead to a great penetration depth of the heat flux. While in 1994 the seasonal thaw depth amounted to 0,32 m, it increased to 1,0 m during the unusual warm summer in 1995 (see Chapter 6.1.3). By the end of August a distinct increase in ground temperature was recorded up to a depth of 4,5 m (Fig. 4.4-1a).

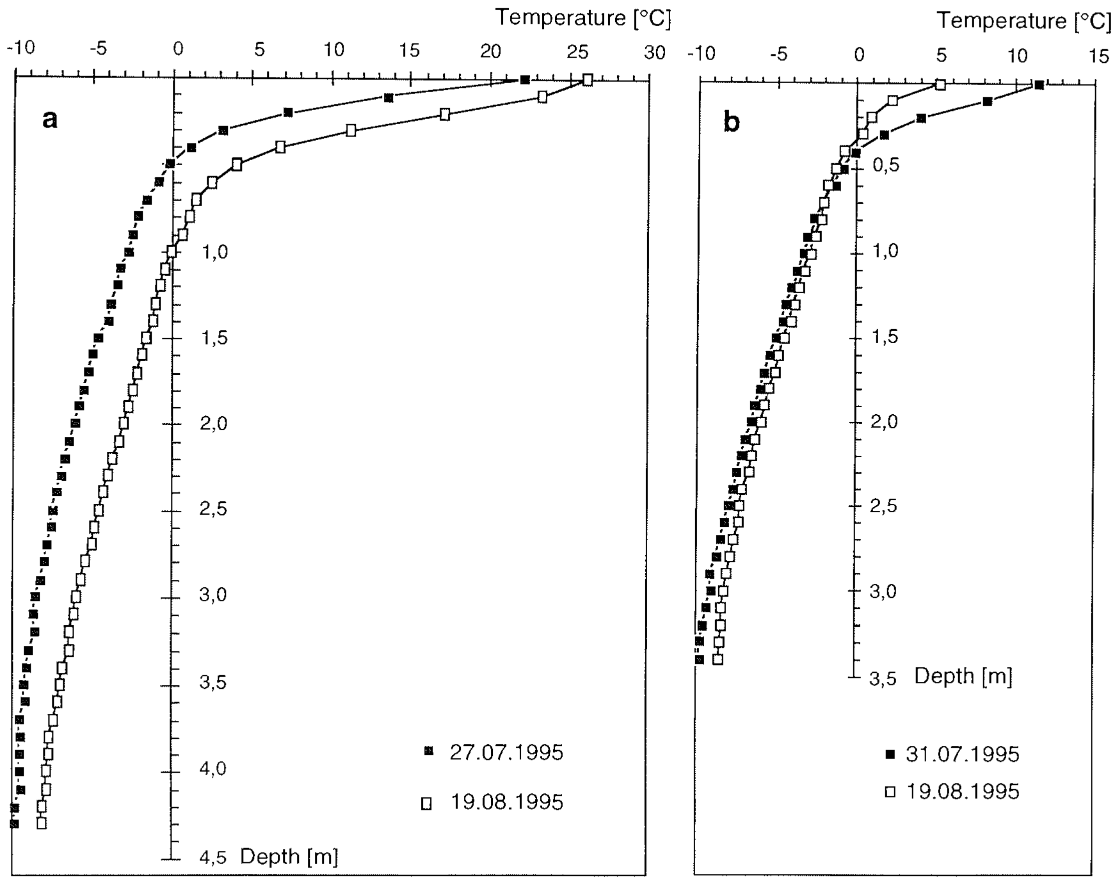


Figure 4.4-1: Ground temperature profiles in a flat, limnic-alluvial depression with peat beds and remnant lakes, northern shore zone of the Labaz Lake; a - borehole LAB 1-94, b - borehole LAB 2-94

The hole LAB 2-94 was drilled on a polygonal surface in the central part of the same fluviolacustrine depression. The polygons are covered by wet tundra with moderate gleying Cryosols (Pfeiffer & Hartmann, 1995). The centres of the polygons were surrounded by water filled trenches following the top of ice wedges. While in 1994 the seasonal thaw depth amounted to 0,23 m, it increases to 0,40 m during the summer of 1995 (Figure 4.4-1b). The near-surface soil temperature increased to a maximum of 11,4 °C. Particular attention should be given to the ground temperature variation during a short cooling period on 15.08.1995. On 19.08., 4 days later, temperatures distinctly near the surface and in the permafrost decreased, indicating that freezing-up had started. The heat flux into the permafrost is buffered by high moisture content in the soil cover, and especially by the very high ice content of up to 90-100 % (gravimetric) at the top of the permafrost.

Hole LAB 14-95 was drilled at the top of a pingo in a lake depression filled by plant growth. Next to the pingo, small remnant lakes exist. The ground temperature distribution characterizes a typical temperature profile in ice-rich permafrost (Fig. 4.4-2). The minimum temperature was -12°C. The depth of 7 m approach to the depth of the zero-amplitude. Because in the Taymyr Lowland, tundra ice-rich permafrost has a great extent, the data from the bore hole LAB 14-95 are typical for many locations.

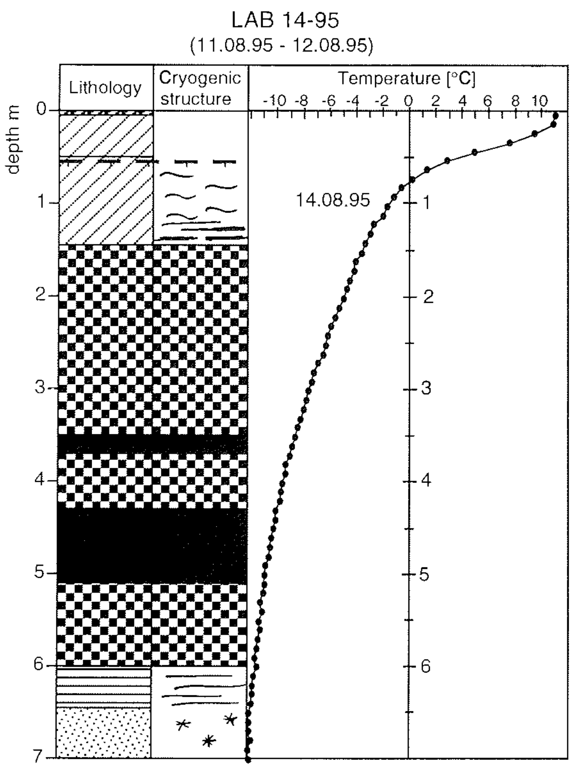


Fig. 4.4-2: Cryolithological and ground temperature profiles at a pingo; borehole LAB 14-95 (for legend see Fig.4.3-3)

4.5 Investigation of ground ice

A systematic sampling of ground ice for isotopic analysis ($\delta^{18}O$, δ^2H, ^3H ratios) was carried out during the field season 1995, complementing data from 1994 (Tab. 11.1-1). Samples were taken at all study sites (Tab. 4.2-1). In addition, sampling of surface water and snow was carried out. All samples of frozen ground or ground ice taken in outcrops or bore holes were thawed in the field. The water was collected in polyethylene bottles and kept at low positive temperatures. The tritium content in the samples will be determined in the Department of Radiochemistry of the Moscow State University by the use of a scintillation spectrometer Tricarb-1660. The $\delta^{18}O$ and δ^2H ratios will be analysed in the isotope laboratory of the AWI and FU Berlin. The results of these studies will contribute to solve the following problems:

Reconstruction of the palaeoclimatic conditions
In order to obtain data on the Late Quaternary palaeoclimate of the investigated area samples were taken in syngenetic permafrost deposits formed in the Post-Zyryansk period. These sediments were accumulated at slopes, flood plains, and in lake mires and shallow lakes. We suppose that processes associated with syngenetically freezing in a subaquatic active layer have affected the special cryostructures in a large part of the lake sediments in the study area. The segregation ice in lake sediments can thus probably supply sufficient proxy-data about changing climate. The expected results in combination with the available data on the isotopic composition of ground ice obtained in 1994 will, therefore, contribute to the reconstruction of climatic changes during the complete Late Quaternary period.

Genesis of ground ice bodies
Samples have been taken at different types of ground ice bodies in order to determine their genesis. Frozen ground facial analysis of the surrounding permafrost and the conductivity data of samples' thaw water permit to classify the studied ice bodies into ice wedges of different ages, a massive ice core of a pingo, buried firn layers, and dead ice bodies. The latter was found at the outcrops LA-24-95 and LA-29-95, having an ice thickness of up to 10-15 m. The dead ice bodies are relicts of the Late Pleistocene (Weichselian) ice sheet, representing the first direct evidence of its existence in the eastern Taymyr Lowland. So far, massive ground ice bodies, regarded as fossil Weichselian glacier ice, are known only from West Siberia and from the most western part of Central Siberia near the Yenissey river (Astakhov, 1992). The planned isotopic and hydrochemical analyses on the ice and age determination of the overlaying permafrost will provide more detailed information on the environmental conditions during ice formation and on geological ages of intensive thermokarst development.

Recent water migration and ice formation in permafrost
Studies on the recent water migration and ice formation in permafrost were continued by means of tritium analysis. Being a component of water molecule, tritium in permafrost can be used as indicator of recent moisture transport in perennially frozen ground. The knowledge of the tritium formation data by

bomb experiments permit to determine the water migration velocity by the use of tritium analysis of ground ice (Chizhov at al., 1983). Using tritium analysis in connection with stable isotopes in ground ice will help to understand the influence of physical-chemical and other geocryological processes on possible isotopic fractionating. In order to study the specific features of mass-transfer between the active layer and upper permafrost horizon under different landscape conditions, a large number of samples have been taken at the drilling transect along the Labaz shore (Fig. 4.3-1, Tab. 4.3-1).

4.6 Mapping of Permafrost landscapes at Labaz Lake

The fieldwork in summer 1995 was carried out in the wider surroundings of the camp at the northshore of the Labaz Lake. The Tolton-Pastakh-Yurakh drainage area marks the rough border of the mapped area. The mapping was based on a Xerox of a topographic map scaled 1:100 000, as there was no map available at a larger scale. The resulting problems concerning the extent of generalisation were reduced by intensive walks in the area during the first 1 1/2 weeks. These walks also indicated that the official mapping which was probably undertaken using air photos, exhibit mistakes. These mistakes were eliminated as far as possible.

The original plan to survey single areas as typical units and to build up a geomorphologic map using remote sensing data could not be pursued because of missing data. As a consequence the whole mapped area and the number of mapped units was reduced whereas the area of the single units was expanded. The single large scaled forms were measured using GPS data, tape-measure and careful study of the map. Single altimetries applying the stadia were used to verify the altitudes in the map. During the expedition the knowledge gained by the mapping was compared with the results of the soil scientists and the quaternary stratigraphic scientists. Especially the soil mapping and the cores which were drilled along a landscape profile (Figure 4.2-2) were interesting. Comparing the results with the sediment series drilled on different levels should render information on the glyptogenesis. For example, one discovered different fragments of terraces, which seem to coincide with changes in the conditions of sedimentation.

Today, most parts of the relief exhibit a slightly rolling character with partly low or very low tilted slopes (Tilt 3°-5°). The altitude rises from 47.5 m at the Labaz Lake up to 102 m in the northern part of the working area. The maximum altitudes are reached at the Piz Labaz (115 m) and west of the Kokora Lake (131 m). In the northern part of the extended area the average altitude rises a few meters. Embedded in this plateau-like area, there are a lot of lakes on very different levels. In addition, small V-shaped valleys with strong evidence of erosion on the valley sides occur within weekly developed valleys. This phenomenon can be traced back on the different erosion levels. A topographic sketch of the mapped area is shown in Figure 4.2-2.

The Labaz Lake and especially the Tolton-Pastakh-Yurakh river are situated in the northern part of the drainage area of the Boganida river while the areas a few kilometres to the north belong to the drainage area of the Novaya river. The Loon Lake for example, which lies about 300 m north of the Labaz Lake shore, drains to the Novaya river. The hydrological circumstances in small areas show some special features concerning their drainage. As in many cases the discharge in many cases does not follow open channels but takes place as suprapermafrostwater, one cannot identify the main drainage of lakes having more than one outlet. The fact that some lakes drain into different drainage areas, give evidence that small differences in the relief intensity have influence on the water discharge and as a result from this on the morphology.

At the northern shore of the Labaz Lake strong erosion takes place. Single runoff rills which are gully-like shifted back leads to large erosion. The high waves on the Labaz Lake during storms and the resulting abrasion lead to the entire reworking of the deposited material on the Labaz Lake shore. According to personal communications of Dolgans, also the spring ice erosion contributes to this reworking.

The erosional forms which are characteristic for this area are the earth slides produced by thermoerosion. These earth slides are especially important in the shore area of lakes and on steep slopes. But the more important shapes are the solifluidal slope processes in its varying forms, which are not visible because of the vegetation cover. Deflation spots are developed on the hillslopes due to the sediment.

On the lake shore of the Labaz one finds large hollow moulds with a diameter of up to 70 meters. These hollow moulds seem to be old thermokarst lakes. Probably these forms originated from corps of buried dead ice, which was found and sampled in the close neighbourhood. The dead ice body probably originated in the Zyriansk period.

There are several areas situated in the lower parts of the relief which seem to be filled up by sedimentation. In these areas more or less large ice wedge polygons are developed. The diameter varies from one to a few meters. The aim is to get more information about the development of the landscape with the aid of the genesis of the polygons. A summary of different morphological processes, is listed in Tab. 4.6-1, in comparison with the main relief elements and their geological age.

Another part of the Labaz northern shore shows Fig. 4.2-3. The surrounding of the Kokora Lake was mapped less intensely than the other part, but it will be interesting together with the results of the coring samples which were taken at the lake during the spring campaign (see Chapter 8.1).

The collected data will now be processed using a GIS. All information collected in '94 and '95, which allow a two-dimensional representation should be used.

Table 4.6-1: Preliminary comparison of morphological processes and main relief elements

CHARACTERIZING SURFACE LANDFORMS	MAIN RELIEF ELEMENTS	GEOLOGICAL CONDITIONS	GEOLOGICAL AGE	MORPHOLOGICAL ACTIVE PROCESSES
slight rolling hills forming watersheds	flat kame-ridges partly with deflation pavement	glacial, glacio-fluvial, glacio-lacustrine	Zyryansk	frost weathering, eolian processes, solifluction in different forms
	single kame-hills	see above	Zyryansk	frost weathering, eolian processes
low tilted slopes	solifluction slopes	different	Holocene / recent	different forms of solifluction, erosion, denudation
	wide drainage channels on the slopes	proluvial sediments	Holocene / recent	different forms of solifluction, thermal and fluvial erosion
terraced lowlands with lakes	flat lacustrine areas with numerous lakes	lacustrine & glacio-lacustrine sediments with plantremains	Karginsk	ice wedge polygons in different stages, frost cracks, different forms of patterned ground, frost heave, intrusive ice, ground ice, solifluction
	depressions of holocene & recent bogland	peat & lacustrine sediments with plant remains	Holocene / recent	ice wedge polygons, frost cracks, different forms of patterned ground, peat plateaus
	hollow moulds originated from thermokarst processes	lake sediments with plant remains, glacial deposits partial with dead ice bodies	Karginsk Zyryansk?	solifluction, mass wasting, denudation, thawing of dead ice bodies, thermal erosion
valleys	flood plane	fluvial sediments with plant remains	Holocene / recent	nivation, thermal erosion, accumulation
	first terrace	fluvial- & peat sediments	Sartan / Holocene	nivation, eolian processes, solifluction, ice wedge polygons in different stages
coastal area of Labaz Lake	beach	fluvial- & lacustrine sediments	recent	shore processes, fluvial processes
	escarpment	different	Holocene / recent	thermal erosion, mass wasting, fluvial erosion, soil creeping, thermal abrasion

5 CHARACTERIZATION OF THE ORGANIC MATTER IN PERMAFROST SOILS AND SEDIMENTS OF THE TAYMYR PENINSULA/SIBERIA AND SEVERNAYA ZEMLYA/ARCTIC REGION

(E.-M. Pfeiffer, A. Gundelwein, T. Nöthen, H. Becker and G. Guggenberger)

Soils are the connecting link between terrestrial ecosystems and the atmosphere. This can be seen especially in permafrost affected soils. Their organic layers play an important role in climate change as carbon sinks and provides a source of greenhouse gases. Soils are also natural archives of climatic and landscape development.
The aim of our field and laboratory work is to investigate the dynamics of carbon and single humic fractions within the scope of the project "The Environmental Development of Middle Siberia". This will be done by an investigation of carbon dynamics which has a dependence on important parameters as microclimate, patterned ground, thickness of active layer, soil reaction, moisture and redox potential at different sites in different Arctic and subarctic ecosystems.
The methods used are the mapping of soils, their organic layers and patterned ground, in situ measurement of carbon production and decomposition, investigation of weathering processes of soil minerals, fractionation of organic matter and characterization by C-isotope investigation.

5.1 Lake Labaz

As a result of the Taymyr-Expedition 1994 a first overview and a preliminary soil map of the Lake Labaz region was presented (Pfeiffer et al, 1995). The Lake Labaz region was subdivided into 11 different soil-plant-patterned ground-units, 6 soil types were described and sampled.
During the Taymyr-Expedition 1995 the soil survey at Lake Labaz should be completed, important parameters of carbon cycle in soils as relief, patterned ground, hydrology, soil substrat, vegetation and climate should be measured, also production, accumulation and decomposition rates of carbon in this subarctic ecosystem.

5.1.1 Materials and Methods

Soil morphology was described according to German soil survey manual (AG Bodenkunde, 1982). The main parameters are the thickness of diagnostic horizons and active layer, transition to the permafrost layers, soil colour (Munsell Soil Color Charts, 1993) and content of organic matter, moisture and proof of free reduced iron with α-α-Dipyridyl, particle size distribution, bulk density, soil structure and texture, soil aggregation, content of stones, root restricting depth, parent material, further on structure and decomposition of the organic material.
The soils were classified according to Soil Taxonomy, 6th edition (Soil Survey Stuff, 1994).
The position of sites were appointed by GPS (Global Positioning System) with a range of +/- 20- 30m.

Disturbed (for chemical analysis and isotope investigation) and undisturbed (for physical analysis and determination of important hydrological parameters as bulk density, water binding and permeability) soil samples were collected from typical soils, partly air dried and prepared for transportation by airplane.
At three sites (sites 3, 4 and 15) annual production and the relation of above- and belowground biomass was determined by harvesting standing alive and standing dead crop and the total below- ground biomass at 1 m^2. For determination of annual turnover rates special litter bags (Minicontainer, Eisenbeis et al, 1995) with different mash size (500 µm and 2 mm), containing typical plants were used. The plant material was dried at 105° C and weighed with an Sartorius Moisture Analyzer MA 30.

Due to the importance of the C-accumulation in surface horizons one main task was the investigation of the organic layers. The spatial, morphological, physical and chemical heterogenity of organic layers are mapped. In association with microrelief forms, vegetation patterns and soil characteristics 11 typical microtopographic units (sorted and nonsorted patterned ground forms) at 7 sites were chosen for further investigations. Morphological properties of each subhorizon were described by thickness, depth, volume, lateral distribution, thickness and pattern of horizon transition, colour, moisture content, fabric, bulk density, root density, fungal density, volume coarse materials (> 2 mm), macromorphology and origin of coarse materials, volume of fine materials (< 2 mm), mineral contents and characteristic faunal elements. In addition, every midday (n=14) the surface and soil temperatures up to a depth of 20 cm were measured in steps of 2 cm with a thermistor PT 100. Moisture contents (n=3) were run on a Sartorius Moisture analyzer (MA 30) for every microtopographic unit.
Subhorizon samples (total and fractions after sieving with 2 mm mesh size) were collected for analytical work (pH, loss on ignition, element contents).

5.1.2 Soils of Lake Labaz Region

The basis of this years investigations was the soil map from Taymyr Expedition 1994. The investigation area was spreaded out (6 km^2), the soils were described more detailled (Fig. 5-1a, soil map Lake Labaz, Fig. 5-1b, patterned ground map Lake Labaz).
More than 90 percent of the moderately hilly landscape of the Labaz Region are covered with loamy-clayey parent materials. The dominant vegetation is subarctic treeless tundra vegetation. The landscape is influenced by numerous lake depressions, thermokarst and solifluction processes. The predominant gley soils are characterized by high water content, low thawing depths, a pergelic temperature regime and free reduced iron. Normally the microrelief is dominated by nonsorted patterned ground like Earth-Hummocks (sites 2, 3, 12). These areas are passed through by water tracks with standing water 5 cm above the ground (site 4), were no patterned ground is visible.
The area of a former lake is now covered with peat of 15-25 cm thickness (site 15), high and low centred polygons are developed. Only the upper 10-25 cm are thawed, the frozen soil has a high ice content. The apexes are relatively dry, the troughs are very wet.
At the top of the hill (115 m, sites 1, 8 and 16), beside the coast of Lake Labaz (sites 10, 20, 22) and beside the river Tolton-Pastach-Jurach (sites 11 - peat! -, 13, 14, 21) sandy and sandy-skeletal sediments are spread, the sediments are

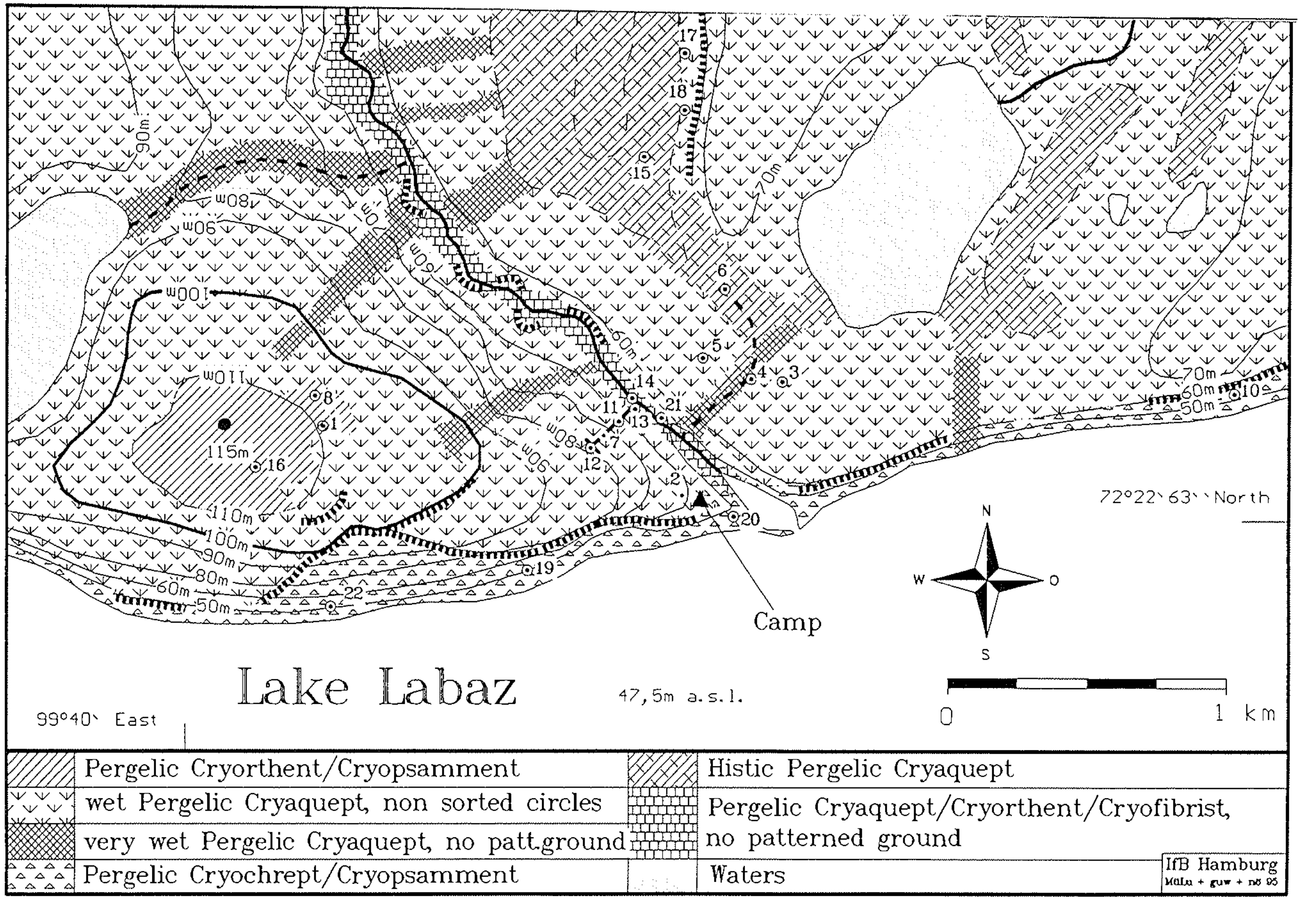


Fig. 5-1a: Distribution of soils, Lake Labaz

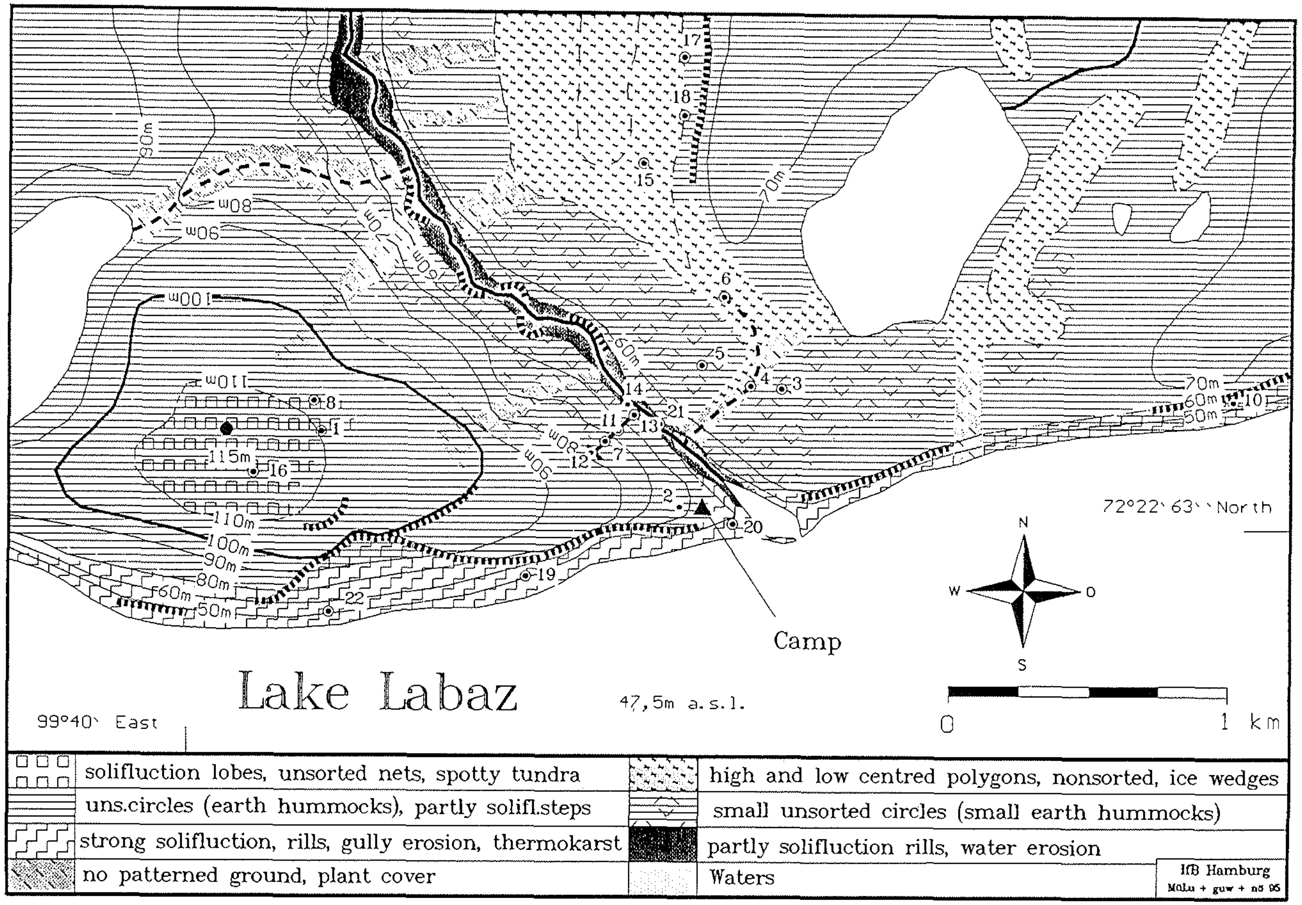


Fig. 5-1b: Distribution of patterned ground, Lake Labaz

changing at narrow distances. These coarse materials are well drained, deeply thawed (thickness of active layer 80-110 cm) and in part clearly weathered. Only the peat-material from site 11 is shallowly thawed (thickness of active layer 10-25cm).

Typical sites were sampled for soil organic matter (SOM) studies. Besides this 3 special buried soils (sites 10, 17, 18) with frozen peat and covered fossil surfaces were sampled in cooperation with the Russian and German geocryologists for common isotope investigation (^{13}C, ^{14}C, ^{18}O) and reconstruction of paleo-environment.

Organic Surface Layers

Tundra soils with underlying permafrost are often covered by a dense mat of mosses, roots and other poorly decomposed plant residues in which up to 95 % of the soil organic carbon is stored (Gersper et al., 1980). These organic surface layers are of major ecological importance controlling fluxes of moisture, thermal behaviour, aeration and nutrient supply (Giblin et al., 1991; Nadelhoffer et al., 1991; Marion et al., 1989). With the increasing thickness of organic horizons summer heat conductivity, soil temperatures and the depth of seasonal thawing are lowered (Harris, 1987). In this cold and poorly drained microenvironment decomposition of organic matter and nutrient mineralization is restricted. Warmer growing seasons in a changing climate with higher soil temperatures, deeper thawing, changes in drainage patterns, increased microbial activity and better nutrient availability will likely affect carbon turnover rates in organic surface horizons (Nadelhoffer et al., 1991, 1992). Therefore during the Expedition 1995 special attention was directed to the characterization of organic surface layers during the field work. This characterization will be supplemented by fractionation of soil organic matter during the laboratory work.

The spatial variation of surface organic layers is highly dependent on the prevailing microrelief unit and macrorelief position. Visible plant components are dominated by root, moss, fibre and wood residues. The highest standing stocks of carbon are found in ice-wedge polygons, tussock tundra and hillslope water tracks. In the center of elevated and better drained microtopographical units midday temperatures are about 12 - 13°C while adjacent depressions are colder (2 - 9°C) with shallow thawing depths. Lateral water movement is strongly related to surface layers. Bulk density and the portion of a higher decomposed material are always greater in subsurface horizons than in surface horizons of the organic layers.
The first results of our field observations at Lake Labaz are presented in Table 5-1.
Our field results confirm the leading role of organic surface layers in subarctic soil processes. Often the organic layers are a better parameter to characterize the ecological situation of permafrost soils. While mineral horizons are often showing similar features and properties (more than 90 percent of the mapped area are gley soils out of clayey loam like sites 2, 3 and 12) organic surface layers can be subdivided into different groups. They are also showing differences of patterned ground structures. Site 3 is a good example for this: carbon and nitrogen contents of the organic layer in the trough (site 3b) are significantly higher than the contents of the apex (site 3a). The contents of the underlying mineral horizon of site 3b are similar to the contents of the mineral horizon of site 3a (compare figure 5-2a-d), the properties of the organic layer

Table 5-1: Organic surface layers of turndra soils at Lake Labaz. First results of field campaign 1995

Soil-plant-patterned ground unit	Microsite of patterned ground	Depth (cm)	Volume (l/m^2)	pH ($CaCl_2$)	Moisture (% dry weight)	Midday temperature[1] (°C)	Bulk density	Coarse fraction[2] (total % volume and dominating components)	Fine fraction[2] (vol%)	Active layer (cm)
Hummock tundra	Apex	0 - 1	4	3,6	115,8	13,5 - 12,0	medial	65 (60 % moss residues, 40 % fine roots)	35	61
	Trough	0 - 7	14	5,4	500,2	9,5 - 3,3	low-medial	90 (90 % moss residues, 10 % wooden roots)	10	25
	Trough	7 - 13	12	5,3	206,3	3,3 - 2,2	high	60 (80 % fine roots, 20 % wood residues)	40	25
Nonsorted stone circles	Center	0 - 1,5	0 - 2	6,8	100,4	13,6 - 12,6	low-medial	65 (90 % Dryas leaves, 10 % wood residues)	35	110
	Trough	0 - 4	0 - 8	5,4	63,2	11,3 - 9,2	very low	70 (80 % moss residues, 20 % fine roots)	30	100
	Trough	4 - 8,5	0 - 9	6,7	92,0	9,2 - 8,4	medial	20 (90 % wood residues, 10 % mosses/leaves)	80	100
Tussock-Hummock tundra	Tussock head	0 - 4	16 - 20	4,7	175,6	13,2 - 13,2 (at 2 cm 13,8)	medial	80 (70 % rhizomes, 30 % fibre rests)	20	61
	Surrounding depression	0 - 7	35 - 42	5,7	662,2	9,7 - 5,3	low-medial	60 (90 % moss residues, 10 % wooden roots)	40	45
	Surrounding depression	7 - 15	40 - 48	5,3	332,5	5,3 - 3,7	very high	25 (95 % roots, 5 % wood and fibre rests)	75	45
High centred ice-wedge polygons	Apex	0 - 4,5	36	2,9	238,4	14,5 - 11,7	medial	80 (90 % fine roots/mosses, 10 % wood/fibres)	20	28,5
	Apex	4,5 - 35	244	3,5	253,9	11,7 - 4,5	very high	10 (100 % fine root and fibre residues)	90	28,5
	Trough	0 - 15	30	4,4	622,0	14,6 - 7,0	low-medial	90 (80 % moss residues, 20 % roots/fibres)	10	42
	Trough	15 - 41	52	4,4	215,2	7,0 - 5,9	very high	40 (100 % root and fibre residues)	60	42
Water track	Flat surface	0 - 10	100	4,8	524,2	8,6 - 5,5	medial-high	70 (70 % fine roots, 30 % fibres/rhizomes)	30	40
	Flat surface	10 - 25	150	4,1	157,6	5,5 - 4,1	very high	40 (90 % roots/rhizomes, 10 % fibres)	60	40
Alder shrub	Trough	0 - 3	30	3,9	54,1	11,8 - 9,3	very low	100 (100 % leaves of Alnus)	-	29
	Trough	3 - 8	50	4,7	360,8	9,3 - 5,6	low-medial	80 (80 % leaves, 20 % wood rests)	20	29
	Trough	8 - 9	10	6,1	584,5	5,6 - 4,8	medial-high	60 (80 % wood/fibre, 20 % leaves/fine roots)	40	29
Birch shrub	Trough	0 - 0,5	5	4,3	50,1	10,3 - 9,5	very low	100 (90 % leaves of Betula, 10 % wood rests)	-	10
	Trough	0,5 - 3	25	4,0	176,3	9,5 - 7,0	medial-high	85 (80 % leaves, 20 % wood/fibres/fine roots)	15	10
	Trough	3 - 4,5	15	5,0	152,0	7,0 - 5,4	medial	60 (60 % leaves, 40 % fine roots/fibres/wood)	40	10

[1]Means (n=14) of upper and lower boundary [2]Fractions after sieving with 2 mm mesh size

are the main difference between the apex and trough. Also the different thermal behaviour is obvious: organic layers have a lower heat conductivity than mineral horizons. The thickness of the active layer of site 3b (trough) with organic material is only half of the thickness of the active layer of site 3a (apex).

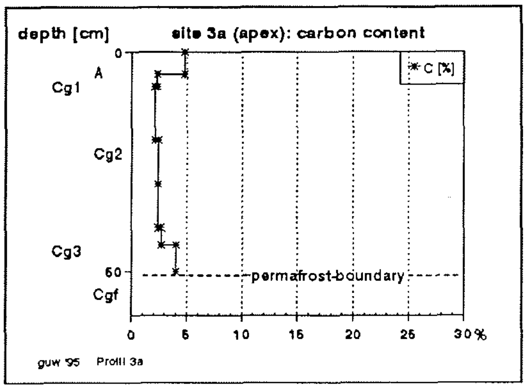


Fig. 5-2a

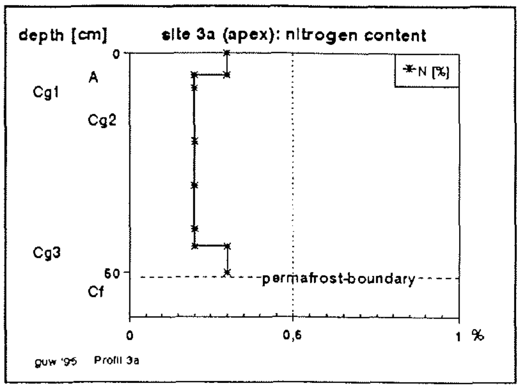


Fig. 5-2b

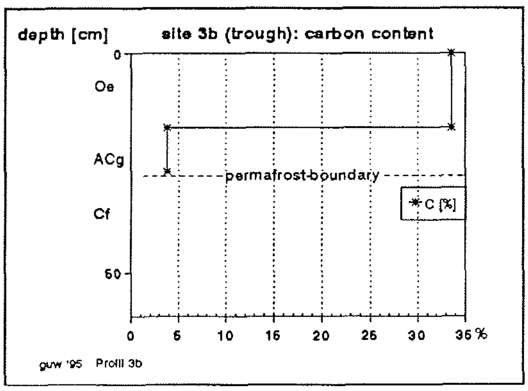


Fig. 5-2c

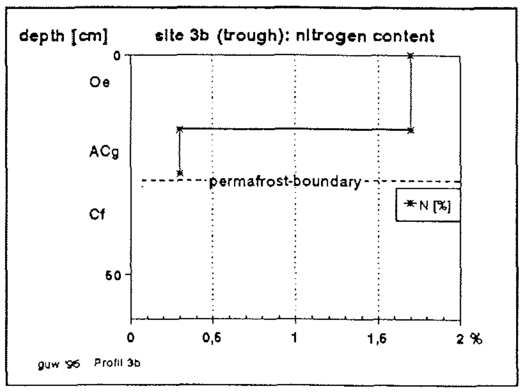


Fig. 5-2d

Fig. 5-2: Carbon and nitrogen content of site 3

- 5-2a carbon content site 3a
- 5-2b nitrogen content site 3a
- 5-2c carbon content site 3b
- 5-2d nitrogen content site 3b

5.1.3 Carbon Dynamics

The determination of annual turnover rates had been started by litter bag experiments. Typical plant (Carex stans, Carex bigelowii arctisibirica) and root material from 5 sites (sites 2, 3, 4, 7, 15) was buried in Minicontainers with different mash sizes at the end of vegetation period. Sites 2 and 3 are typical, wide spread wet sites, site 7 is a relatively dry, well aerated, coarse-sandy and deep thawed substrat and site 15 again is a typical location with ice wedges and low centred polygons. The litter bags should be excavated in 1996.
Turnover rates for tundra ecosystems are published from Barrow/Alaska, they are lying between 1 g/m^2 for above-ground and 25,5 g/m^2 for below-ground biomass (Webber, 1978).
The turnover measurement will be continued next year.
In co-operation with Kiel the annual plant production of different sites (site 3, 4 and 15) was determined by harvesting standing dead, standing alive crop and below ground biomass.
The selection of living roots from the below ground biomass was very difficult, there ist still a great span of error. The results of the harvesting campaign are presented below (Table 5-2).

Table 5-2: Above- and below ground biomass Lake Labaz [g/m^2]

location	aboveground alive			aboveground dead			Σ	belowground alive + dead
	grass	leaf	total	grass	leaf	total		
site 3 apex	total	total	total	n.m.	n.m.	total	157,4	4239,3
site 3 trough	42,5	19,4	61,9			95,5		4310,3
site 4	151,4	5,1	156,5	n.m.	n.m.	132,8	289,3	8359,8
site 15 trough	70,9	1,2	72,1	40,1	0,4	40,5	112,6	17999,0

These data are joint work of M. Sommerkorn/Kiel and A. Gundelwein/Hamburg.
Site 3: the relation of apex : trough is 4-5 : 6-5 (4-5 apexes/m^2, apex-diameter 36 cm).

The annual above-ground production of higher plants in subarctic tundra ecosystems are lying around 50-80 g/m^2 (51.1 g/m^2 site V at Barrow/Alaska, Webber, 1978), the total annual production (above- and below-ground) is lying around 320-800 g/m^2 (Taymyr-Peninsula, Vil'chek 1991). Sites 3 and 15 are laying in this range, the above-ground biomass of site 4 is distinctly higher than the values of Barrow/Alaska. Vil'cheks values for annual production are giving an order for the share of below-ground dead biomass of sites 3 and 4 (ca. 90 percent). The very high value of site 15 is caused by the difficult separation of dead roots and peat, there is still a great span of error.

Basing on Vil'cheks values for below-ground biomass the share of above-ground biomass amounts ca. 13-15 percent for sites 3 and 15 and round about 30 percent for site 4. These shares are typical for a subarctic tundra like Barrow/Alaska. The share of above-ground biomass for an Arctic tundra is laying higher: round about 36 percent of the total living biomass of an Arctic Tussocktundra (comparable sites 2 and 3 of Lake Labaz) are above-ground biomass, ca. 45 percent of total living biomass of a shrub tundra with ice wedges (comparable site 15) are above- ground biomass (Alexandrova, 1958).
Fractionation and isotope investigations of the soil organic matter are in progress.

5.2 Lake Levinson Lessing

5.2.1 Materials and Methods

The methods used for the fieldwork are the same as described for Lake Labaz region. Only the investigations of the biomass are different: at Lake Levinson Lessing parallel samples were taken at two points in time, in the beginning and at the end of August. The above-ground biomass was not separated into standing alive and standing dead crop.

5.2.2 Investigation Area

The investigation area is located at the Taymyr Peninsula (74°N, 98°E) in Middle-Siberia, and is a part of the Byrranga folded zone. The landscape is characterized by hilly to steeply dissected landforms and valleys with meandering streams. The Levinson-Lessing-Lake depression is considered as a result of tectonic movements of the crust in blocks (Bolshiyanov and Anísimov, 1995).
The altitude above sea level ranges between 40-450 m. Strong to moderate solifluction features are typical for the slopes of the hills . In contrast to this, the valleys and the riverbanks are characterized by ice wedge structures like high and low centred polygons.
The main vegetation of the region belongs to a typical tundra zone, with some characteristics of the Arctic plants (Zhurbenko, 1995).

5.2.3 Soils of Lake Levinson Lessing Region

Two major groups of soils can be distinguished: the soils of the river-terrace, and the soils of the slopes (Fig. 5-3a, soil map Lake Levinson Lessing, Fig. 5-3b, patterned ground map Lake Levinson Lessing). The differences are mainly caused by the influence of solifluction on the soils of the slopes and polygon dynamics of the river-terrace soils.
Most soils in the river plain are soils with aquic soil moisture regime, pergelic soil temperature regime and histic epipedon (site 3). Only at some places at the river sites - like polygon mounds or high centred polygons - dryer soils are developed (sites 8, 10). They often show a ca. 0.5 cm thick, reddish brown to yellowish brown (5YR4/6 - 10YR5/6) layer with an enrichment of ironoxide.
The soils on the slopes are very strongly affected by solifluction, differences

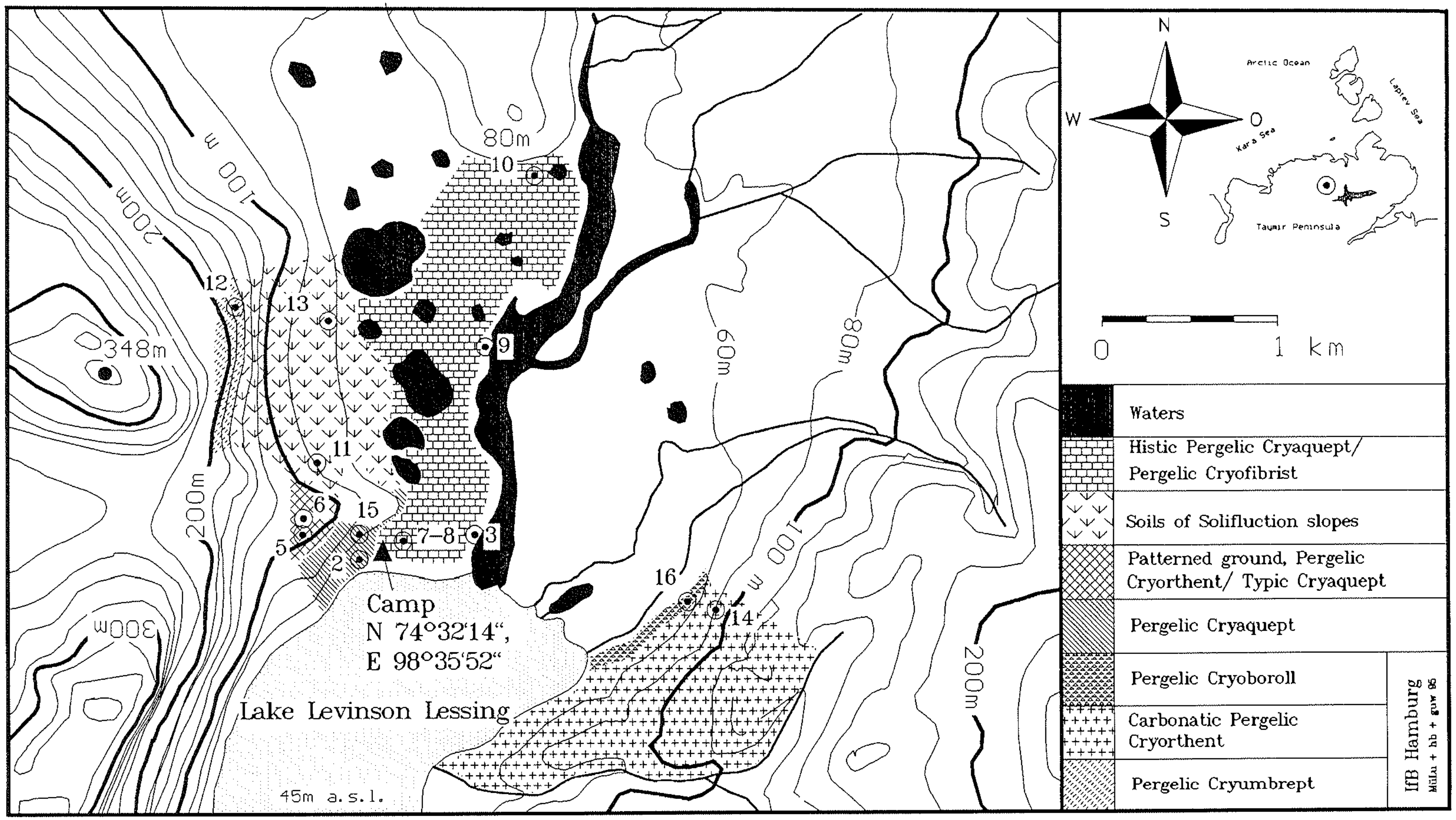


Fig.5-3a: Distribution of soils, Lake Levinson Lessing

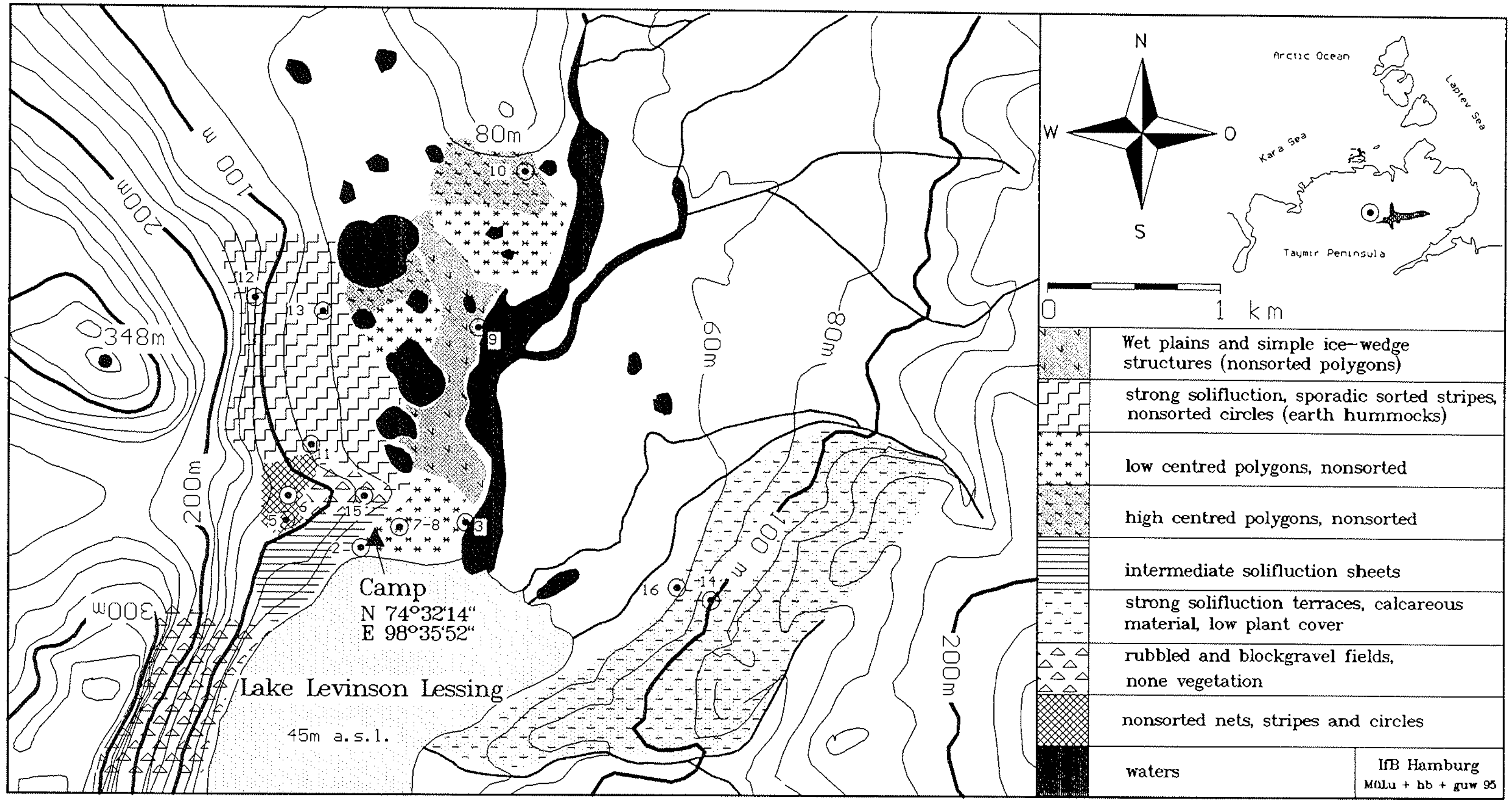


Fig.5-3b: Distribution of patterned ground, Lake Levinson Lessing

between soils of the same slope are caused by a different soil moisture regime and different particle size classes. Pergelic Cryaquept are common (site11). The mineral soils on the slopes are only less developed, reduction processes are predominant.
On the saddle between slopes 3 and 4 soils with fragmental to skeletal particle class size, low vegetation coverage, and patterned ground like unsorted nets on the upper weak slope site and unsorted stripes on the steeper slopes are spread (sites 5, 6, Pergelic Cryaquept). Unsorted nets could be found with gradients about 0-5 , up to gradients of 14 unsorted stripes are common.
The unsorted net pattern is connected with moderately wet soils and an active layer depth about 80 cm (during August). In contrast to this soils of the unsorted stripes are very wet, so it was impossible to reach the permafrost by digging. The measurement of thickness of active layer in soils with high contents of rock fragments was very problematic.
The Bedrock of slope 2 consists of calcareous parent material (marine terrace), the soils differ from other slope soils. The plant cover is very sparse and the ground is weak. On the soil surface stone pavements are dominant and solifluction lobes occur. Only in small depressions and grooves could Dryas octopetala dominated vegetation be found. The typical soil is a Pergelic Cryorthent (site 14). In contrast to that the soils of the accumulation domain of the slope are humus rich and dark (10YR3/1; site 16, Pergelic Cryoboroll).

The soils of the solifluction slopes are in the main less developed soils like Pergelic Cryaquepts and Pergelic Cryorthents.

5.2.4 Carbon Dynamics

For investigations concerning production and decomposition of organic carbon an experimental site was prepared. This site represents a typical tundra site of the Lake Levinson Lessing region. Above- and below-ground biomass was harvested and litter bags buried. The results of the harvesting campaign are presented below (table 5-3), the values for total below ground biomass are similar to the values of Lake Labaz, the values for total aboveground biomass are smaller.

Table 5-3: Above- and below-ground biomass Lake Levinson Lessing [g/m^2]

time	aboveground	belowground
mean value beginning of August	52,6	3004,2
mean value end of August	47,8	3771,9

In 1996 it is planned to excavate the litter bags at Lake Labaz and Lake Levinson Lessing, and further on to complete and finish the soil investigations at Lake Levinson Lessing.

5.3 Soil organic matter in different permafrost-affected sites of the Severnaya Zemlya Islands/ Arctic Region

5.3.1 Objectives

In contrast to the distinctly developed tundra soils of the Labaz-Lake and Levinson-Lessing-Lake regions located on the Taymyr Peninsula, the soils of the islands of Severnaya Zemlya are quite virgin. The comparison of the soil organic matter (SOM) dynamics at the different sites under investigation will reveal detailed information on the carbon turnover in terrestrial ecosystems of different climatic zones (boreal, subarctic and Arctic). SOM turnover and input by soil erosion contribute significantly to the recent OM pool in limnic sediments. Therefore, the importance of SOM for the carbon fluxes in the main compartments of the periglacial landscapes (plant communities, terrestrial soils, limnic and fluviatile sediments) will be estimated. Questions concerning the origin (terrestrial, limnic or marine) of OM in lake sediment could be answered by comparative studies of SOM and limnic OM.

Our investigations will focus on two goals:
a) analysis of the organic matter quality and recent carbon accumulation processes in permafrost soils under Arctic conditions using C-fractionation, structural chemical analyses, and isotope analysis;
b) assessment of the origin of organic matter in lake sediments of Severnaya Zemlya by applying various terrestrial biomakers techniques and isotope measurements.

The C-turnover studies of the different permafrost-affected ecosystems will help to understand the development of the climate and the environment of Middle Siberia since the Quartenary.

5.3.2 Materials and Methods

Typical patterned grounds (according to Washburn, 1958) and their soils were described and sampled in the same manner as was done at Lake Labaz and Lake Levinson Lessing (US Soil Survey Manual, 1993 and Arbeitsgemeinschaft Bodenkunde 1982).
Little soil pits were dug in of 10 sites for soil description and measurment of the thickness of the unfrozen layers. About 87 samples were collected for pH, C, N and isotope analysis (53 soil and 34 plant samples) and about 25 soil and 25 plant samples were taken for the terrestrial biomarkers research.

5.3.3 Short characterization of Severnaya Zemlya Region

We focused our investigations on the biggest islands of the Severnaya Zemlya Archipelago, Bolshevik Island, October Revolution Island and Komsomolsk Island, located in the Arctic Ocean between Kara and Laptev Sea (N°78-81 and E°79-106, Fig. 5-4).
The landscape is characterized by glaciers with wide periglacial areas, permafrost features and lake depressions. The highest elevation is 965 m. The main vegetation types are Arctic deserts and Arctic tundras with about 26 higher plants like *Papaver polare, Saxifraga nivalis, S. oppositifolia, S.*

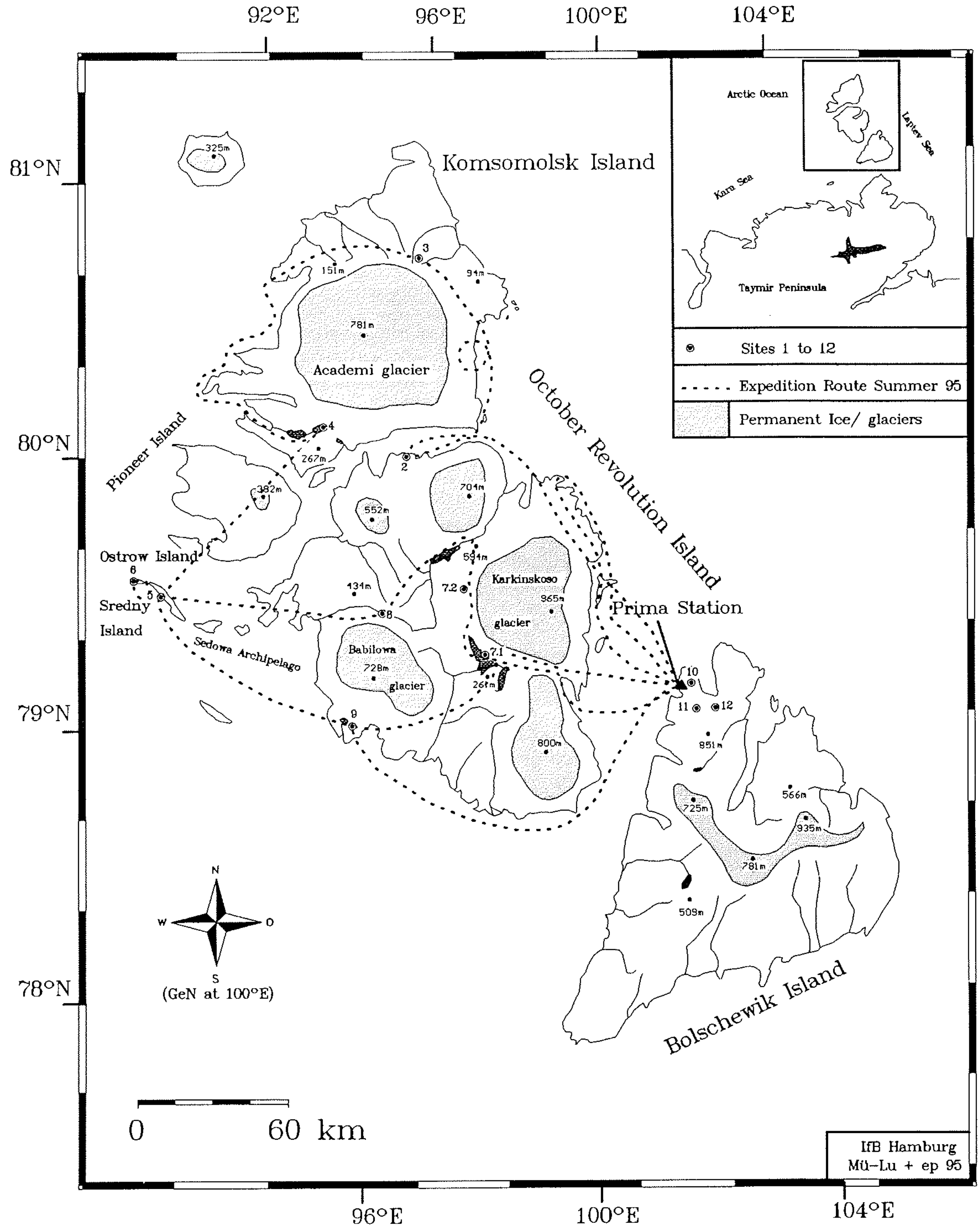


Fig. 5-4: Severnaya Zemlya, expedition route 1995

caespitosa, Carex arctisiberia, Deschampsia brevifilia. Mosses and lichens are the predominant plants with the highest degrees of coverage.
The climate is characterized by a mean July air temperature of about 3°C (mean annual air temperature: - 13°C), about 45-60 days with temperature above 0°C and a mean summer precipitation of about 60 mm. The mean soil temperature in 50 cm soil depth is about -5°C.

5.3.4 First results

5.3.4.1 Soils of Severnaya Zemlya Islands

The landscape is strongly influenced by water and wind erosion processes. Soil drifting is obviously seen by rill, gully and sheet erosion and stony deflation layers in the outwash plains. Under such conditions the soil development is very restricted. Only virgin and weakly differentiated soils are typical for Severnaya Zemlya (Mikhaylov, 1960).
Besides Arctic desert soils, calcareous and non-calcareous Arctic soils, hydromorphic non-gley soils, gley soils and Arctic tundra soils with humus accumulation and weak weathering horizons are predominant. The O-C- and A-C-profiles have a high content of stones. All soils have a pergelic soil temperature regime (soil temperature below 0°C in 50 cm depth).
Soil development of the different island sites depends on the parent material, patterned ground, vegetation, geomorphological and hydrological situation.

Most soils show a very high water content due to the infiltration of melting water into the fine textured surface horizons, the impermeable permafrost layer, high slope water influence and low evapotranspiration during the Arctic summer. The typical moisture regime is aquic, although they posses only very weak hydromorphic features. Reduced Fe^{+2} (weak α-α-Dipyridyl-reaction) could be found only in the lake depression sites. One reason may be the low contents of weathered elements (Fe, Mn, S) due to the limited chemical weathering under the Arctic conditions. In addition O_2 rich slope water could be responsible for the lack of reduced iron at some sites.

Important to the characterization of soil types is the differentiation of soil organic material due to the patterned grounds as sorted and nonsorted types (Washburn, 1980). The accumulation of organic material in O/A-horizons is the predominant process. Distinct developed A horizons with accumulation of humic material could be found especially on older moraines and vegetated outwash sites with higher degrees of plant coverage, a dry soil moisture regime and a deep permafrost layer due to the coarse soil texture and high amounts of stones.
The thickness of the thawing layers (active layer) depend on climatic variables (solar radiation, snow cover, precipitation) and soil properties which control the heat permeability of the soil (e.g. water/ice contents, the particle size of the soil texture, content of stones). The thickness of the active layer at the sampling sites ranges between 0.35 m depth in fine textured soils and more than 0.85 m depth in coarse textured soils. Permafrost could not be found in dry and coarse fragmental sites where there is not enough fine material to store enough water to form permafrost layers.

5.3.4.2 Carbon and nitrogen contents

The first soil analysis have been finished. The organic carbon of the A-horizons ranges between 0.5 and 11.5 %. The organic surface layers (O-horizons) have TOC (total organic carbon) values of about 21-44 %. The mineral subhorions have organic carbon contents of about 0.1 %. Corg.. The dissolved organic matter varies between 3.4 and 27.2 mg/l for the surface horizons.
The total nitrogen of the A-horizons have an average value of 0.2 % N (min: 0.01; max: 0.7).
The soil reaction of the most mineral soils ranged between medium acid and weak basic (pH of 5.2 to 8.6) due to the parent material.
The isotope investigations have been started and will be finished in the next month.

5.3.5 Planned research in 1995/96

5.3.5.1 SOM and Isotope analysis

One of the main research activities during the planned Severnaya Zemlya expedition in 1996 are the SOM studies due to the special patterned ground situation (soil organic matter in non-sorted and sorted forms). The degree of decomposition, boundaries, quantity and distribution of roots, structure and amounts of mineral particles are important.
The main parameters of carbon-cycle-temperature, acidity, moisture, redox-potential - will be measured at some typical sites (initial to weak developed soils).
The comparison of the C-characteristics of the Arctic soils with the tundra soils will allow to calculate the typical C-turnover in this region.

For some selected sites the main and trace elements and the dithionid-soluble-iron - as an indication of weathering - will be analysed by the appropriate techniques (FRA, AAS, graphite furnace AAS).

The characteristic $\delta^{13}C$-values of plants, soils and sediments will give information about the origin of the organic material in the different landscape elements (lakes, rivers).

The $\delta^{13}C$-values will be determined in different SOM fractions (methods according to Beudert, 1988; Elliott and Cambardella, 1991; Ping et al, 1994) and of the origin plant material (C-chief source). The data should help to understand the carbon turnover of permafrost affected sites under Arctic conditions.

5.3.5.2 Terrestrial Biomarkers

The question concerning the origin and processing of OM in lake sediments are of particular importance in some lakes of the Zevernaya Zemlya islands, e.g. the Fjordonoje (Fjord) Lake and, the Izmentchivoe (Changeable) Lake on the October Revolution Island. These lakes have been developed from former fjords, which became isolated from the sea by the intruding glaciers. Thus they changed from salt water sites to freshwater lakes. This change must be documented in an alteration of OM composition in the sediments. In recent times, the major portion of the OM input is believed of terrestrial origin. In order to characterize the input of terrigenic organic matter into the lake sediments we will assess the chemical composition of the dominating terrestrial plant species, define specific biomarkers for these plants, and follow the processing of selected organic compound classes in the mineral soil. Plant and soil samples were taken by hand from 10 representative sites of Bolshevik Island, October Revolution Island and Komsomolsk Island (Annex, Tab. 11.1-5). Soil development ranged from pure polar deserts [Pergelic Cryopsamment] to organic crusts [Pergelic Cryorthent] to soils with distinct humus accumulation in the mineral surface soil (humic A horizon) and first indications of development of colour (browning) [Lithic Cryorthent]. The samples were air-dried at the Prima Station in order to reduce microbial activity before shipping to St. Petersburg.

Structural chemical analysis will include the characterization of lignin, one of the most refractory, chemically uniform, and source-specific biochemical constitutents of organic matter. Lignin in non-woody tissues and soils will be estimated using the system of lignin parameters obtained from alkaline CuO oxidation (Ertel & Hedges, 1984). CuO oxidation products are used to characterize the amount and composition of lignin in woody and non-woody plant tissues, and to investigate the sources and diagenetic state of lignins in soils and sediments (Nelson et al., 1995). In contrast to lignin, carbohydrates are more labile and are common structural and storage compounds in terrestrial, limnic and marine organisms. However, compositional patterns of carbohydrates will be useful for source identification and description of diagenetic behavior of labile organic matter components (Hedges et al., 1994). Thus, the implications of the lignin-based characterizations will be tested by the concurrent analysis of hydrolyzable carbohydrates.

As opposed to the degradative techniques, ^{13}C nuclear magnetic resonance (NMR) spectroscopy will allow a broad characterization of structural features of isolates and of bulk soil samples. ^{13}C NMR spectroscopy will be a useful and definitive characterization tool in demonstrating chemical differences among organic substances from different environments (Malcolm, 1990).

The knowledge of organic matter alteration in soils and sediments will support the interpretation of sediment composition and depositional history based on mineralogical and isotopical analysis of the lake sediment cores to be sampled during the 1996 campaign.

The power of organic biomarkers to contribute to a palaeoenvironmental data archive increases, if soil and sediment analyses will be accompanied by analyses of sediment trap materials, limnic and marine plankton, and soil bacteria.

5.4 Co-ordination with other working groups

The planned SOM investigations will be co-ordinated with the other working groups of the common project. The characterization of soil organic matter in combination with vegetation and microbial activities - done by the colleagues of Kiel - will help to understand the processes of carbon-cycle and decomposition of SOM under permafrost conditions of subarctic and Arctic sites. The comparison of the SOM from the different climatic ecology sites

along a south-north transect is one of the main tasks.
The research of isotope analysis and terrestrial biomarkers will be done with Dr. Guggenberger/ University of Bayreuth and will give information about the origin of organic matter in the Arctic lakes.

The knowledge of the recent soils processes in connection with the results of the geo-cryopedology research of the lake sediments in the region of Labaz, Levinson Lessing and Severnaya Zemlya - done by the colleagues of Potsdam - are important for the reconstruction of the paleoclimate and the environmental changes.

6. MICROBIOLOGICAL AND BOTANICAL STUDIES

6.1 Introduction
(M. Bölter, H. Kanda and M. Sommerkorn)

The 1995 expedition has had two parts, on the one hand we continued our studies at Labaz Lake with emphasis on the field studies on gas exchange measurements of plant communities and soils, on the other hand we had a visit to the site at Levinson-Lessing Lake and to Severnaya Zemlya. The studies at Labaz Lake were carried out by Martin Sommerkorn, the report of these studies is given below (Chapter 6.2). This report reflects the data of the botanical study carried out during the field season.
Levinson-Lessing Lake and several sites at Severnaya Zemlya were visited during August 2 - 16, 1995. Samples for preliminary microbiological studies were taken and analysed. The report of this expedition contains two parts: site descriptions and microbiological data (M. Bölter, Chapter 6.3 and Tabs. 11.1-4, 11.1-6) and a preliminary list of plants which were monitored in the field as well as after first laboratory analsis (H. Kanda, Chapter 6.4, Table 11.2-1). Site descriptions would have been incomplete without the help of Prof. Shuhei Takahashi, Kitami Institute of Technology, Kitami, Japan, who provided us the concomitant GPS data and we wish to express our thanks to him. During this trip to the Northern Islands we also compiled a list of birds which came across our ways (Table 11.2-2).

6.2 Labaz Lake
(M. Sommerkorn)

6.2.1 Objective

As pointed out above and in last year's report (Sommerkorn, 1995) the main objective of this year's expedition was the measurement of aerob carbon fluxes in main tundra types of the Labaz area. Within the scope of the project this study should lead to the knowledge on the ratio of primary production to microbial respiration and further on the carbon balance of the tundra system. In combination with micro- and mesoclimatic measurements over the seasons, conclusions can be made about the carbon accumulation processes in the present and past and thus about the development of the Middle Siberian Tundra.

6.2.2. Methods

For this year's study we concentrated on the two dominating tundra types of the Labaz area, i.e. humid tussock tundra and wet sedge tundra, of which vegetational and soil characteristics were described during expedition Taymyr '94 (Sommerkorn, 1995). During our field campaign from 18.7. to 2.9.1995 diurnal *in situ* measurements of CO_2 fluxes were carried out on typical plots by means of a seven channel infrared CO_2 analyzer, working in open system (Walz, Germany). The equipment consists of six non conditioned non transparent cuvettes for measuring soil respiration and one conditioned transparent cuvette for measuring primary production and soil cryptogamic coupling.

In order to relate the observed CO_2 fluxes to the ambient clima, all variables that influence aerob carbon fluxes were measured continuously. A climate station (Driessen und Kern, Germany) provided data for air temperature, humidity, radiation, precipitation, pressure, wind speed and direction. Microclimatic measurements of soil temperatures in various depths of typical plots were continuously carried out by use of data loggers (Grant, UK). In addition, at these plots active layer depths were measured. The water status of the soils was analyzed by means of wells and a Moisture Analyzer (Sartorius, Germany). Redox potentials measurements were taken out by our coworkers from the Institute for Soil Science of Hamburg.
Special attention was given also to the heterogenity of the tundra, especially to small scale morphological differences (tussocks/depressions).

6.2.3 Results

6.2.3.1 Climatic and microclimatic conditions

This years summer was warm and dry (Fig. 6-1) Average ambient temperature was 12,8°C for the period from 20.7. to 31.7. and 10,6°C for the period from 1.8. to 25.8. Total precipitation for the whole period was 38,2 mm.

For humid tussock tundra surface temperatures up to 54°C have been measured on tussocks during periods of maximum radiation and absence of wind (Fig. 6-2). In depressions the temperature was somewhat lower but also reached 49°C (Fig. 6-3). In wet sedge tundra, where sun heated surface water ran off, soil surface temperatures reach up to 25°C (Fig. 6-4) The temperature profile was therefore most pronounced on the tussocks, where a 54° gradient was observed over the 50 cm depth of the active layer. The insulation properties and constant wetness of the moss layer enabled a 49°C gradient within the 38 cm in the wet depressions of the tussock tundra. In the soils of the wet sedge tundra we observed the highest homogeneity in temperatures. This is thought to be because of the high thermal capacity of water, which flows constantly through the whole active layer.

Water table in wet sedge tundra and in tussock tundra showed wide differences. In wet sedge tundra the soil was found to be water saturated. The water table was constantly situated just below the green part of the moss layer which covers this tundra type by 100 %. Only after the rare rain events this moss layer was sometimes flooded for several hours.
In the tussock tundra water table varied much more over the field season. In depressions it was found between 5 and 2 cm below surface, the values below the tussocks ranged between 15 and 11 cm below surface.
In the upper horizons of tussock tundra soil moisture was affected by microtopography, substrate and weather conditions. In general, tussocks

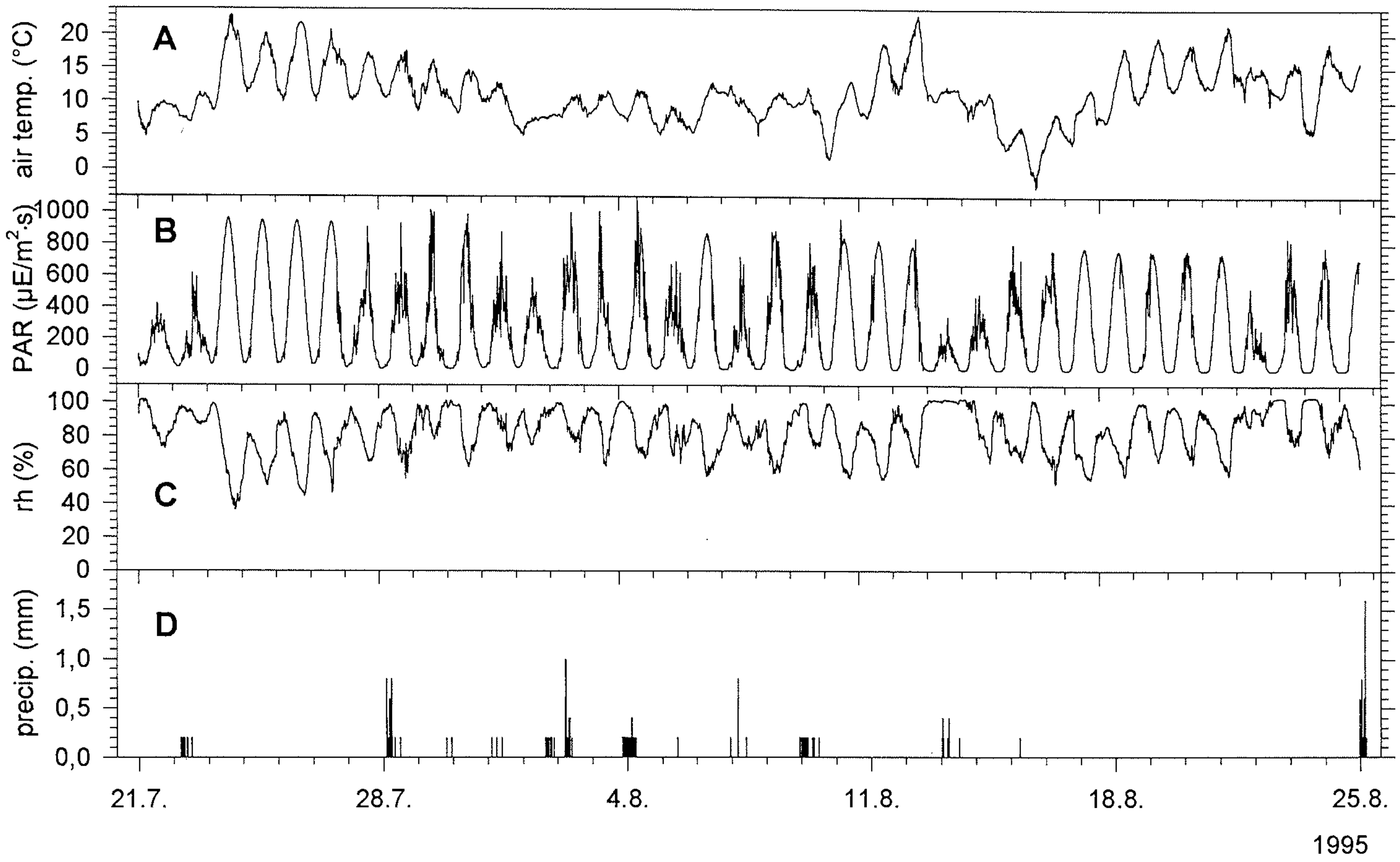


Fig. 6-1: Climate data from Labaz weather station for field season 1995
A: ambient temperature; B: photosynthetic active radiation; C: relative humidity; D: precipitation

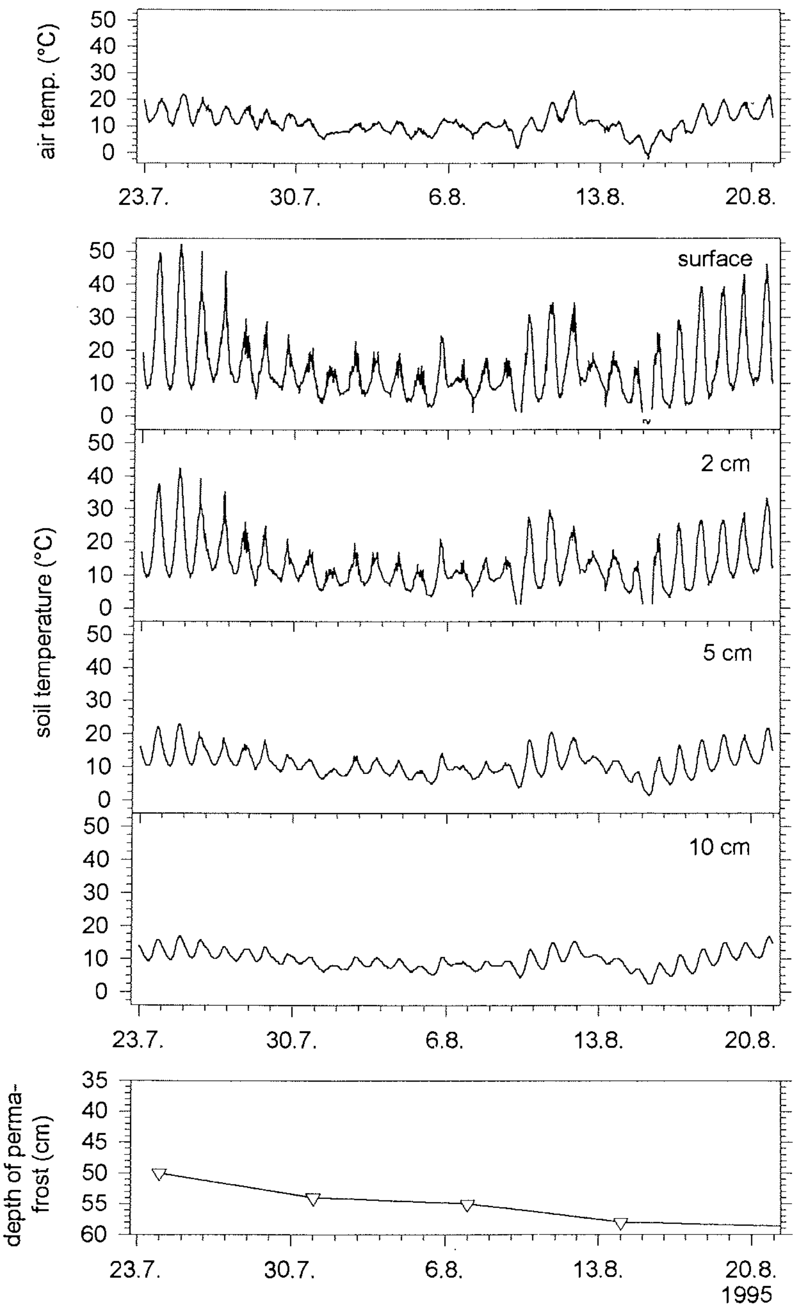


Fig. 6-2: Ambient temperature, soil temperatures and depth of permafrost in humid tussock tundra, tussock

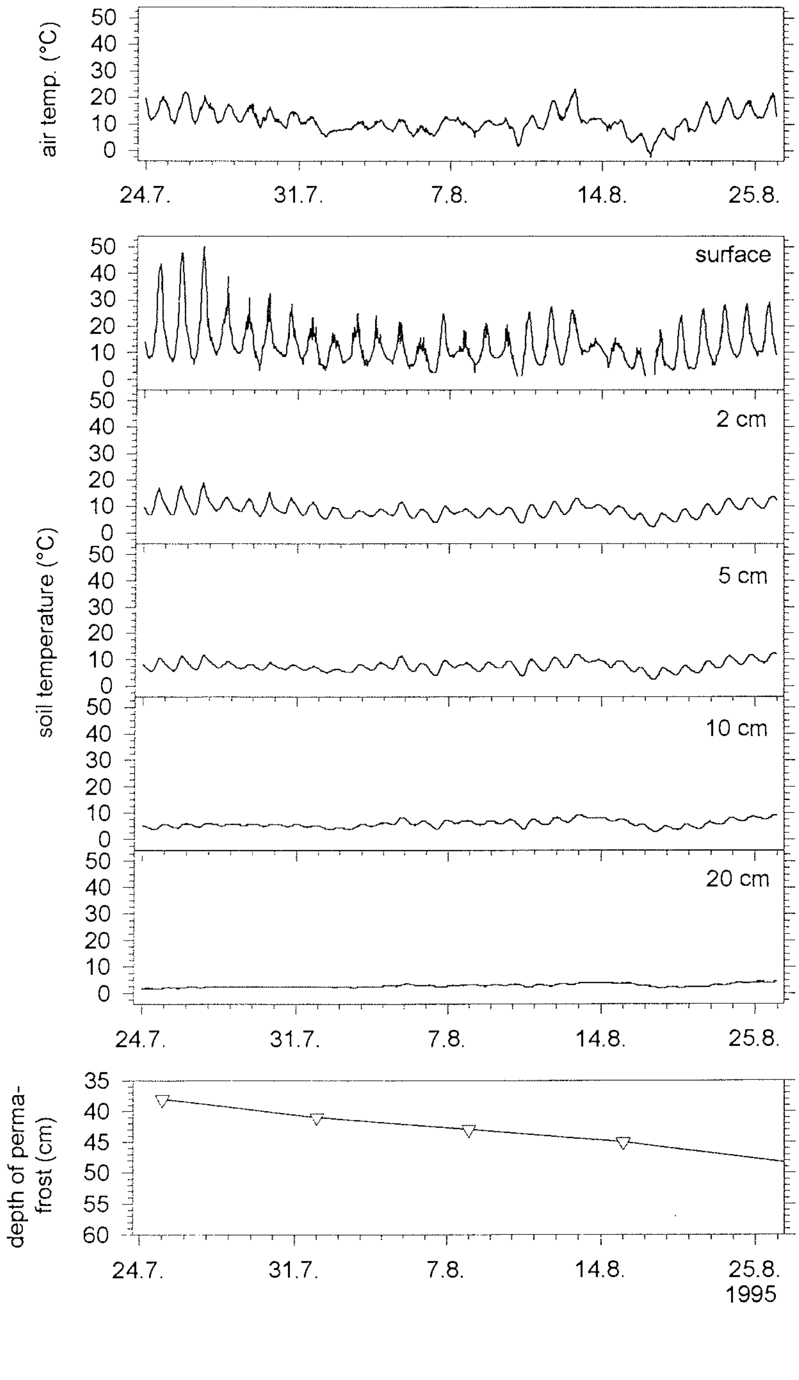


Fig. 6-3: Ambient temperature, soil temperatures and depth of permafrost in humid tussock tundra, depression

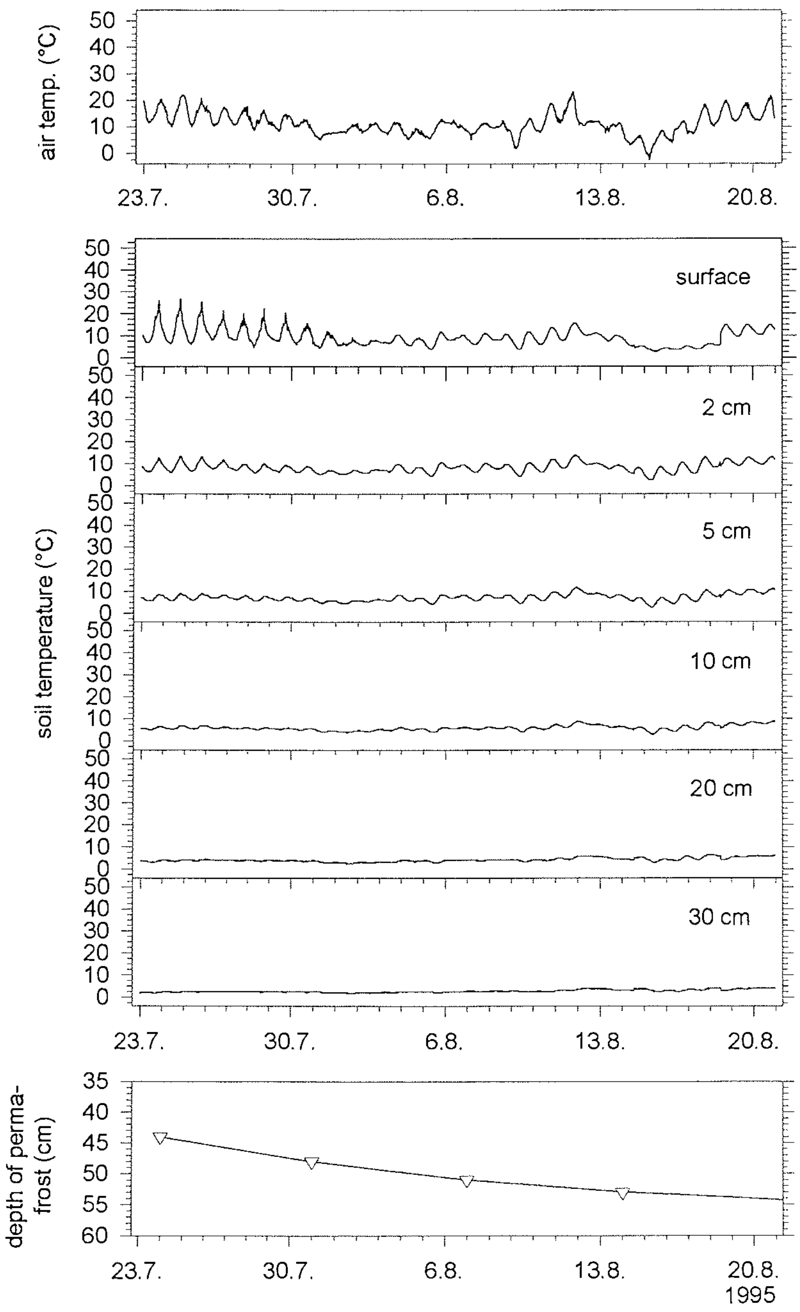


Fig. 6-4: Ambient temperature, soil temperatures and depth of permafrost in wet sedge tundra

appeared to be much drier than depressions. Too, they showed more reaction to weather conditions. As an example the moss layer on top of a tussock showed a humidity of 35 % after a dry period, whereas at the same day the moss layer of the neighbouring depression showed a humidity of 91 %.

6.2.3.2 CO_2 flux measurements

Lots of work has to be done to the in situ CO_2 flux data, so that only one typical diurnal experiment should be presented here (Fig. 6-5). The chosen plot was a medium high moss carpet in tussock tundra, the experiment was running from noon to 16 pm the next day. Air temperatures above soil (and inside the cuvette) reached a maximum of 12°C and a minimum of -3°C in the night. On this cloudy day maximum values of PAR (Photosynthetic Active Radiation) were not higher than 600 $\mu E/m^2s$, except for some very short sunny periods. A period of photosynthetic darkness occured for about 3 hours at night. Soil temperatures (not shown) in 5 cm depth varied between 3,5 and 5,5°C that day.

Focusing on soil respiration only, the system looses carbon in the form of CO_2 by about 25 to 40 mg CO_2/m^2h. Capable to reach maximum photosynthetic values already in low light intensities, *Tormenthypnum nitens*, which dominates the plot, fixed CO_2 at rates between 30 and 65 mg CO_2/m^2h over long periods of the day. The net system CO_2 balance for the soil/moss system of this plot was positive over the day but went over to negative values during night, when photosynthesis ceased because of darkness.

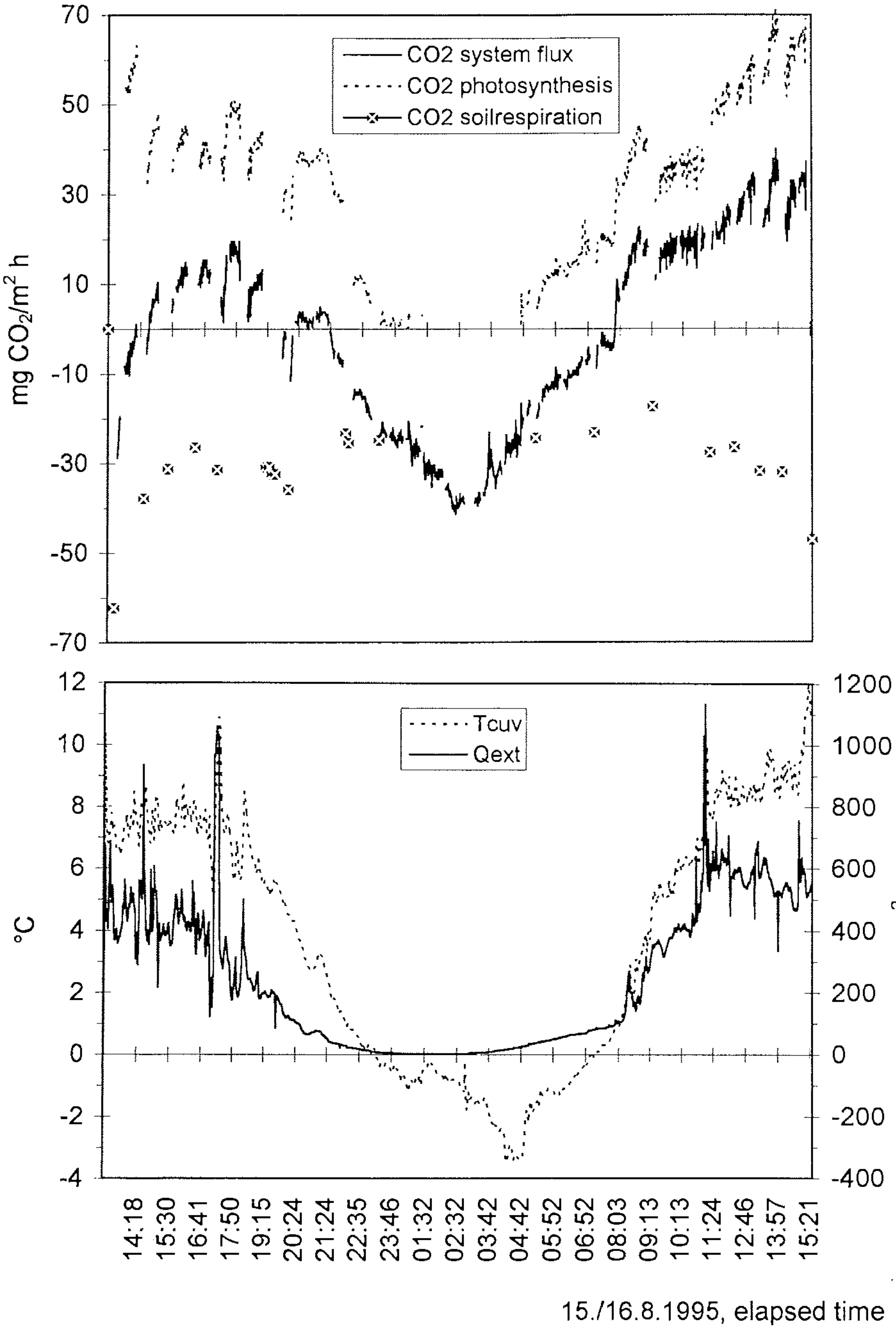


Fig. 6-5: Diurnal CO_2 fluxes of soil-moss-system in humid tussock tundra, depression

6.2.3.3 Harvests

To evaluate the amount of biomass as well as the vascular plant production of typical plots of the various tundra forms we harvested several fractions of the aboveground plant material. The belowground biomass will be analyzed by our coworkers from the Institute for Soil Science, Hamburg. As a first result we determined the dry weight of the harvested material (Table 6-1).

Tab. 6-1: Dry weight of harvesting fractions of typical tundra plots. III is tussock tundra, T tussock, D depression, IV is wet sedge tundra. Sample size is 1 m^2.

Sample	g DW
III D monocot. production 95	19,5
III D woody dicot. production 95	9,9
III D aboveground dead	28,2
III D wood	not determined yet
III T monocot. production 95	23
III T woody dicot. production 95	9,5
III T aboveground dead	67,3
III T wood	not determined yet
IV monocot. production 95	151,4
IV woody dicot. production 95	5,1
IV aboveground dead	132,8
IV wood	not determined yet

6.3 Soil Microbiology
(M. Bölter)

A. Site descriptions and general remarks

6.3.1 Taymyr Peninsula

The visits to the sites of investigation at Labaz Lake and Levinson-Lessing Lake were used to get a preliminary impression of the environments for future plans in this project. The visit at Labaz Lake was rather short (4h), visits were made only to the field camp and the sites where the actual program is running (by M. Sommerkorn), more time was spent at Levinson-Lessing Lake.

The comparison of these sites has shown that the latter region will provide a good opportunity to continue the studies during next field seasons with special respect to comparisons of soils and vegetation along a south-north transect as proposed in our basic program. The environment at Levinson-Lessing Lake shows a great variety of different biotopes, starting with wet tundra up to barren soils on fjells. Thus, in the vicinity of the camp we can take samples from very different types of soils and vegetation for studies of the botanical and microbiological inventory as well as for studies on their biological activities in relation to environmental properties. During our discussions we found this as an excellent place to perform a program on soil science, soil microbiology and vegetation analysis.

Soils and plant samples from a transect close to the camp at Levinson-Lessing Lake were taken. They are used for a pilot study for soil microbiological purposes (see appendix 11.1-6) in the laboratory in Kiel.

6.3.2 Severnaya Zemlya

The next places visited were at the archipelago of Severnaya Zemlya. Various places were inspected for soils and their microbial community. Generally, these places can be described as Polar Deserts, although higher plants, mosses and lichens can be found at nearly all places. However, plant distribution is more patchy and differs significantly from stands at the Taymyr Peninsula. Mats of grasses or other higher plants are very rare and vegetation cover shows the characteristic of opportunistic growth, related to special environmental properties such as depressions or ridges. The most denude area was found at Komsomolsk Island north of the Akademik Nauk Glacier.
The dominant character in these environments is posed by the permafrost and herewith related landscape patterns. This holds true for fjells and also for wet sites in the vicinity of lakes or rivers. On the other hand, we find areas of real polar deserts where soils show the typical desert pavement with pebbles and stones, surface soils show vesicular structure typical for deserts. Sites in this environment can be regarded as biological young biotopes in contrast to those mature environments at Taymyr.
Relationships between plants and microbes are interesting for studies on the establishment of biocoenoses especially in the root systems of different vascular plants. Further, the harsh enviroment acts as an inhibitor for complete degradation of organic matter and leads to accumulations of particulate matter underneath cushions of higher plants (e.g. *Saxifraga oppositifolia, Novosieversia glacialis*) where nearly non-humified material can be found. Such microenvironments provide nice model systems for studies of degradation and accumulation processes in polar landscapes. It is also of great interest to follow seeding strategies of higher plants as well as cryptogams. Basic soil formation processes can be related to organic matter from soil algae, fungi and bacteria. Thus, barren soils may show primary steps in microbiologically initiated formations of soil crusts which become niches for mosses or vascular plants.

In summary, both places, Levinson-Lessing Lake and Bolshevik Island (Severnaya Zemlya) will provide necessary information for explanations of environmental development of Arctic tundras. Fresh deglaciated areas were found and can be analysed for soil science, soil microbiology and vegetation analysis at the northern islands, mature biotopes and their actual behaviour in biological activity are available in different situations in the Levinson-Lessing Lake region. For our next steps in studies of polar environments and their development after the last ice age both stations seem necessary to be investigated and compared for final interpretations of environmental development in this region. The results of this study will be used to establish a concrete research program for the next campaigns.

B. Preliminary results of laboratory analyses.

1. Samples.

Samples of soil surfaces and plant samples were taken at different places (see site descriptions in appendix, Tab. 11.1-4), they will be inspected for the microbiological inventory (algae, fungi, cyanobacteria, bacteria) by microscopical analysis. Preliminary analyses on organic matter shall give first impressions about relationships between dead and living organic matter. Contents of organic matter as determined by loss on ignition (LOI in % of d.wt., 550° C) and actual water contents can be found in Tab. 6-2. Highest values for LOI (>20%) were found only in surface samples or in layers of cushions. Samples with no layer of plant material do not show strong gradients.

2. Microscopic analyses.

The data obtained are restricted to bacteria as analysed by epifluorescence microscopy. Fig. 6-6 presents the data of the total bacterial counts (TBN). It becomes evident that each profile shows a decrease in bacterial number by depth, a fact which is also true for total bacterial biomass (BBM). Mean cell volume (MCV), however, shows a different picture (Fig. 6-7). This parameter of the bacterial community is not directly related to the total organic matter, to total bacterial counts or to total bacterial biomass.

Relationships between these parameters are depicted in the graphs of Figs. 6-8 and 6-9. Fig. 6-8 shows that both, TBN and BBM can be related to LOI (Figs. 6-8a, b), a fact which, however, is due to the close relationship between TBN and BBM (Fig. 6-8c). Fig. 6-9 shows concomitantly the relationships with MCV. It becomes evident that the mean cell volume varies only in a range between 0.04 and 0.08 μm^3, i.e. by a factor 2, unless other parameters (TBN, BBM, LOI) increase in much higher ratios.

The mean cell volume of a bacterial community is related to its size structure either via length or biovolume measurements. Fig. 6-10 shows 2 examples samples from Levinson-Lessing Lake and from Bolshevik Island. Sample LL1.1 (LOI=54.4%) shows a size distribution of bacterial lengths up to 2.5 µm, whereas sample BI3.2 (LOI=6.0%) shows maximal values <1.75 µm. Such frequency distributions can be used as fingerprints of samples or profiles, they can be separated individually from each other by appropriate statistical methods.

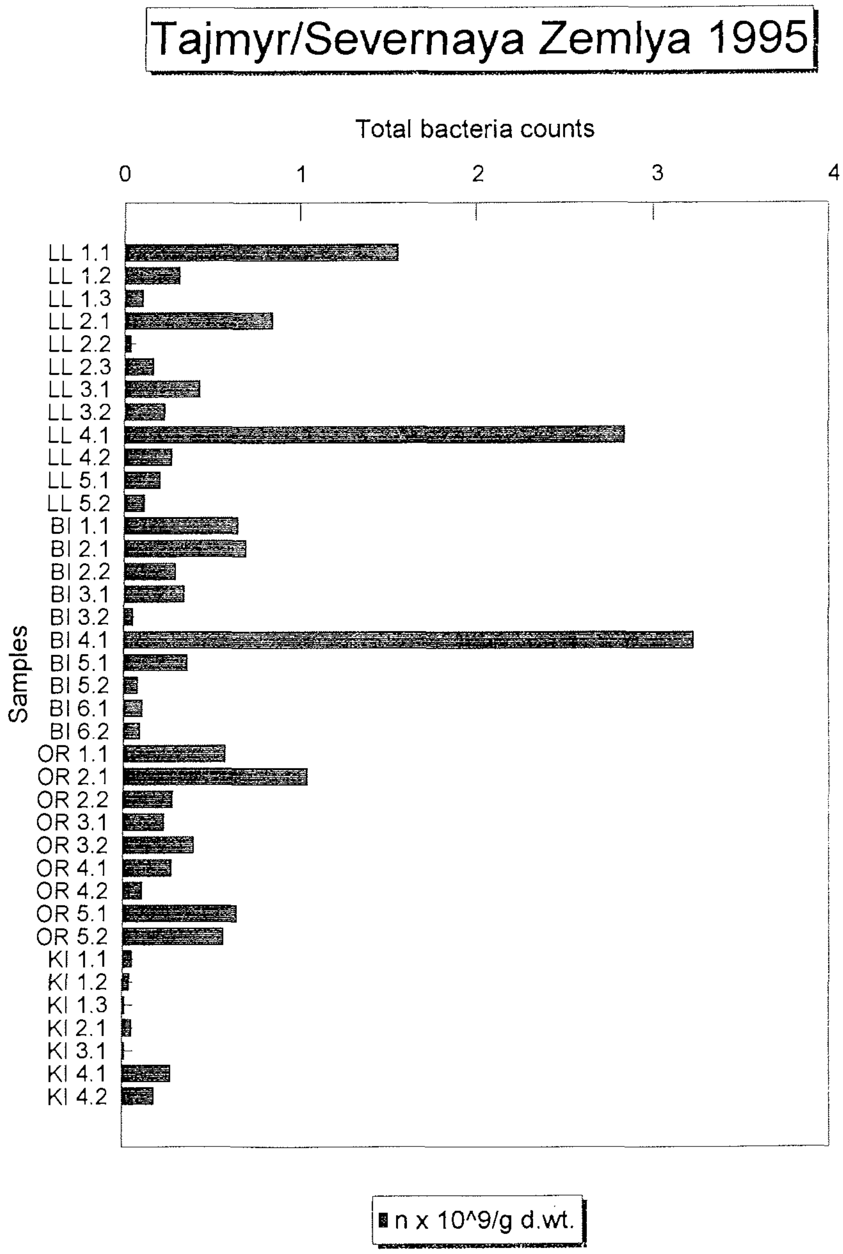


Fig. 6-6: Total bacteria counts of samples from Taymyr and from Severnaya Zemlya. For *abbrevations of samples see Table 6-2*

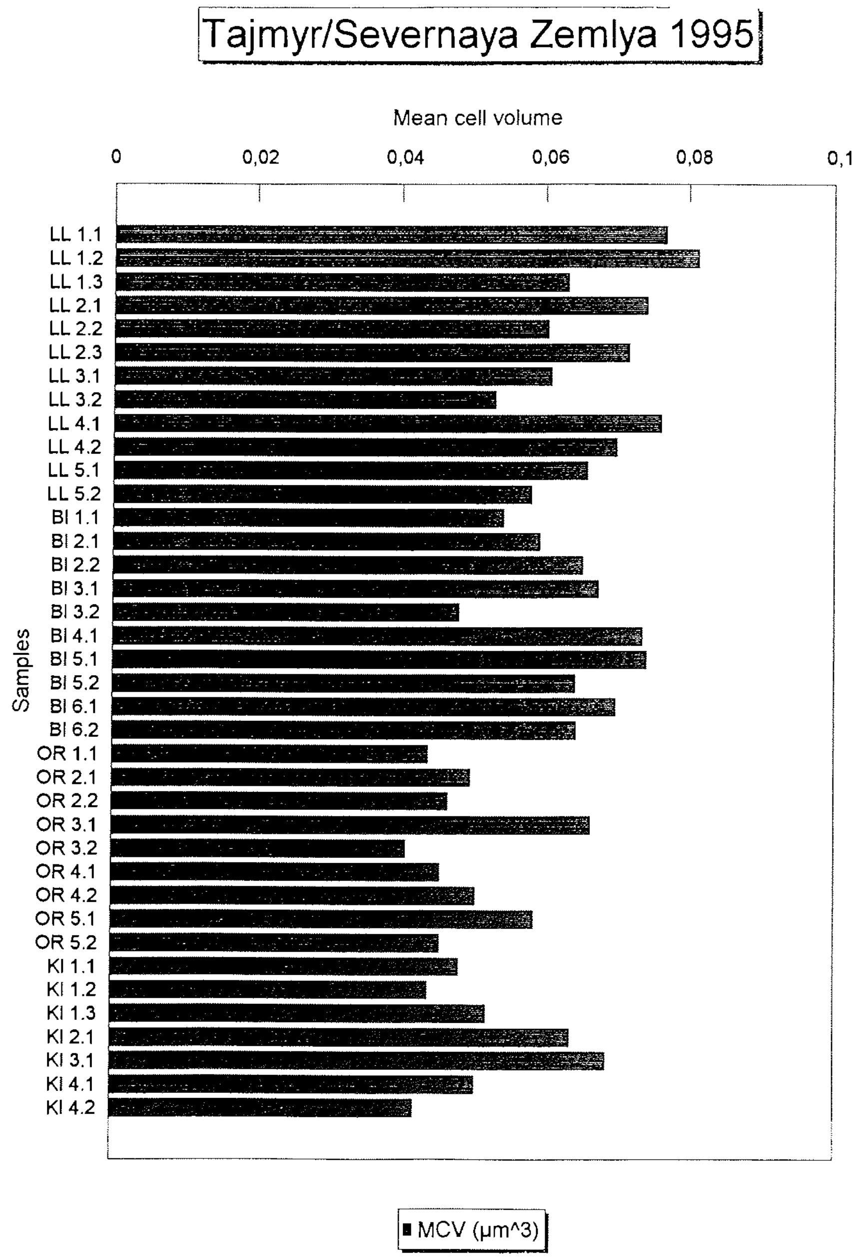


Fig. 6-7: Mean bacterial cell volumes of samples from Taymyr and from Severnaya Zemlya. For abbreviations of samples see Tab. 6-2

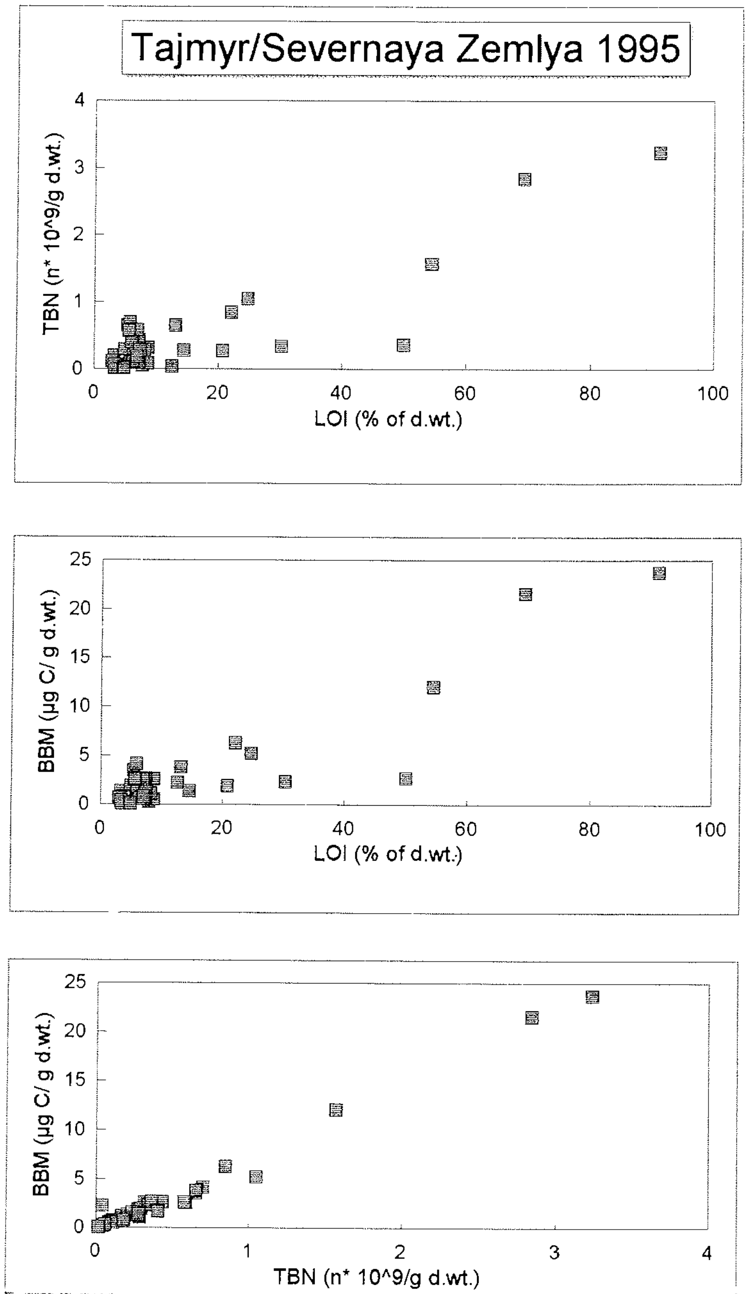


Fig. 6-8a-c: Relationships between parameters of bacteria (TBN=total counts, BBM=total bacterial biomass)

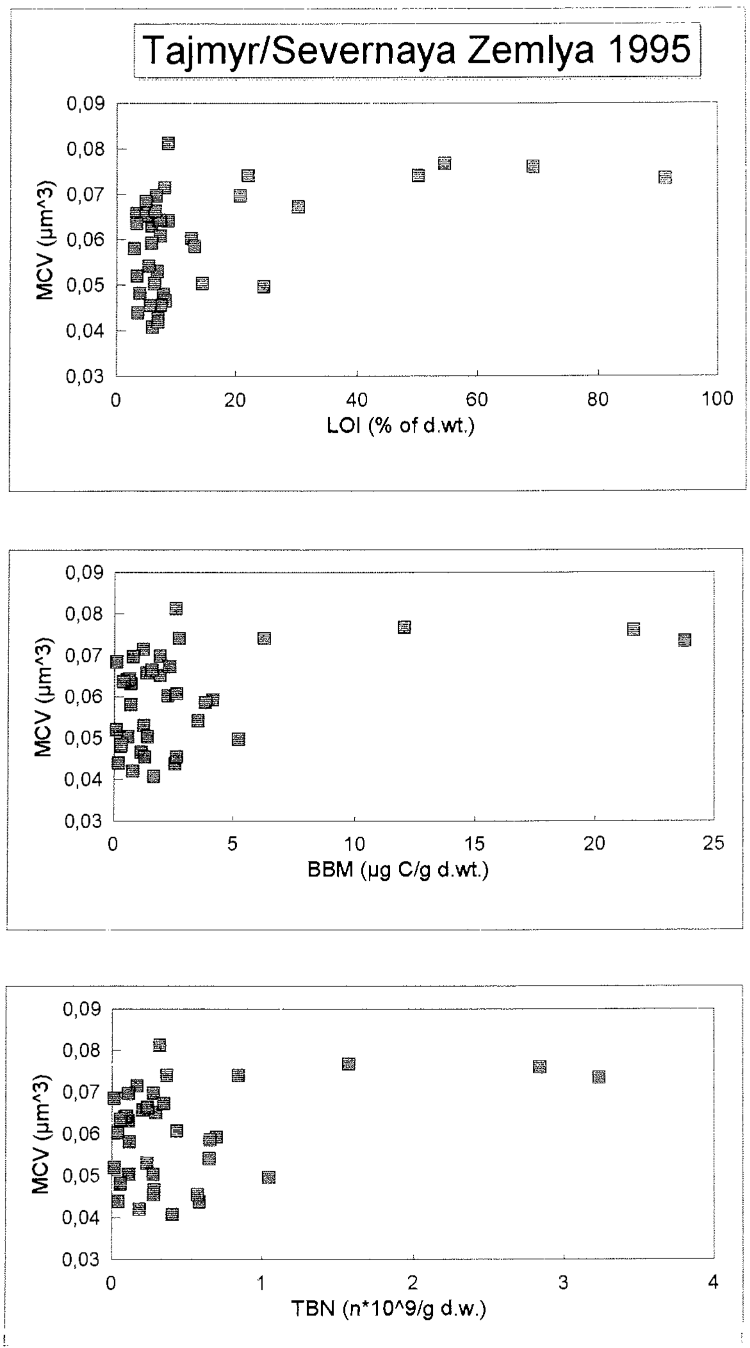
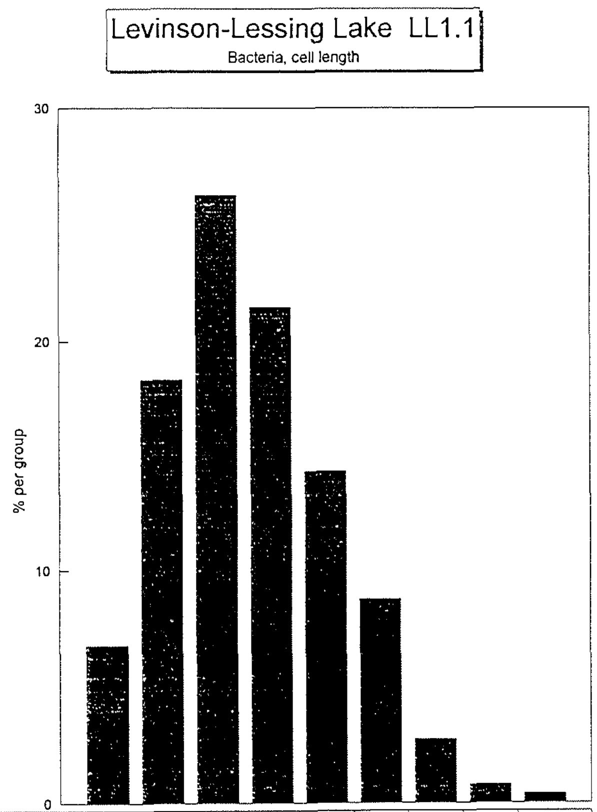
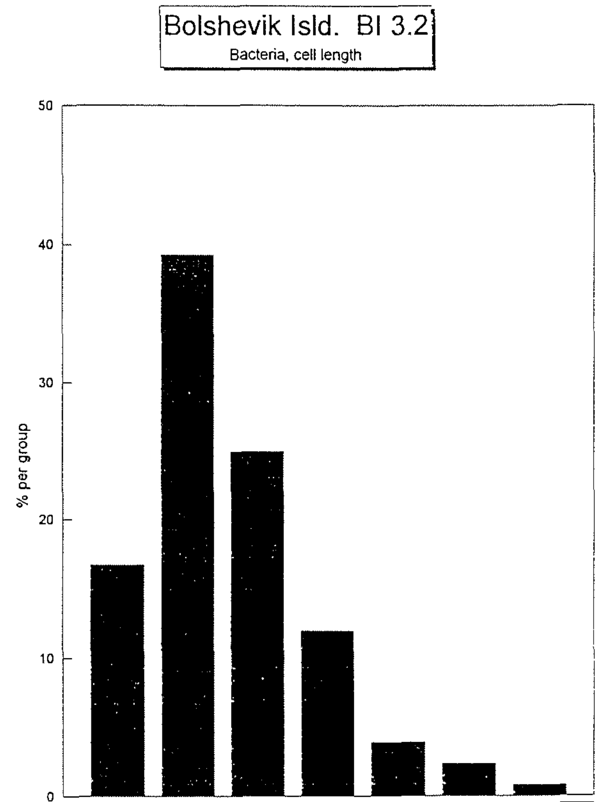


Fig. 6-9a-c: Relationships between parameters of bacteria (TBN=total counts, BBM=total bacterial biomass, MCV=mean bacterial cell volume) and loss on ignition (LOI) for samples from Taymyr and Severnaya Zemlya



size class [µm]	0,25	0,50	0,75	1,00	1,25	1,50	1,75	2,00	2,25
% per group	6,77	18,33	26,29	21,51	14,34	8,76	2,79	0,80	0,40

n = 251



size class [µm]	0,25	0,50	0,75	1,00	1,25	1,50	1,75
% per group	16,67	39,29	25,00	11,90	3,97	2,38	0,79

n = 252

Fig. 6-10a, b: Distribution of bacterial size classes in samples from Levinson-Lessing Lake (LL1.1) and Bolshevik Island (BI3.2). The first two columns (0.25 and 0.5) refer to cocci (diameter), all other to rods (length)

6.4 Botanical studies
(H. Kanda)

During the visits of the sites at Taymyr Peninsula and Severnaya Zemlya plant species were identified in the field, sampled and identified in the laboratory at NIPR. The latter holds mainly true for mosses and lichens. Although not all collected material could be identified up to now, a preliminary list of the species known today will be given below. Further investigations, mainly on cryptogams, are necessary and will be published later in appropriate reports. Details of plant communities can be reported from 12 sites which locations are given in Tab. 11.1-4, 11.2-1. Plants which are suggested to be "dominating" species are obviously due to the percepted snapshot, not to vegetation analysis, species which were identified in the laboratory are marked separately.

6.5 Geobotanical studies
(Yu. Novozhilov and M. Schnittler)

Contrary to temporate areas the myxomycetes of Arctic regions have not yet been researched effectively. Taymyr peninsula is no exception to the rule.
As shown by several studies in Alaska (Stephenson & Laursen 1993) and Greenland (Goetzsche,1989) and some separate data from Canadian Arctic the myxomycetes have been found up to the coldest regions of the northern hemisphere.
The field work was carried out during a fortnight period (20 July-5 August 1995). The scientific group consisted of Yuri Novozhilov (V.L. Komarov Botanical Institute of the Russian Academy of Sciences) and Martin Schnittler (Institut für Vegetationskunde, Bundesamt für Naturschutz, Bonn, Germany).

6.5.1 Localities

Studies were mainly carried out in the following collecting sites:
1. Khatanga, nearly from cuty, 72°00' N, 102° 00' E
2. Kaiak, Kaiak river, 5 km of SW of Kaiak, 71° 30' N, 103° 00' E
3. Zhdanicha, Khatanga river, region of golf Nuzhdina, 72° 17' N, 103° 22' E
4. Zhdanicha, Khatanga river, region of golf Oboinaia, 72° 28' N, 104° 15' E
5. Norilsk, Talnach, Krasnyi Kamen, 69° 29' N, 88° 32' E

6.5.2 Material and methods

All vegetation types were thoroughly examined. Common and easy recognizable myxomycete species were only occasionally collected, but rare species and such which are not easy to recognize in the field were permanently collected.
We defined all sporocarps which may arise from one plasmodium as one specimen. In practice, we assumed those sporocarps which shared the same substrate and which are separated by a distance which can be overcome by a migrating plasmodium belong to the same plasmodium. This reflects the biology of myxomycetes and is already accepted in some ecological and

biogeographical works (Eliasson 1981, Stephenson 1988).
From almost all collections sporocarps were preserved as permanent slides in polyvinyl lactophenol and/or glycerol gelatin, to distinguish between limeless and lime-containing structures. In several cases sporocarp structures were studied with a JEOL 35c scanning electron microscope in St. Petersburg.
For evaluation of abundance, a simple estimation scale according to Stephenson et al. (1993) was adapted:
r - rare: recorded once or twice
o - occasional: recorded 3 - 5 times
c - common: 6 - 15 records
a - abundant: more than 15 records.

Apart from field collections samples for the moist chamber experiments were chosen from the bark of each tree species especially from *Larix sibirica, Juniperus communis, Salix sp., Duschekia fruticosa (=Alnaster fruticosa), Picea obovata, Betula pubescens* and also from litter of different herbaceous plants (*Archangelica, Thalictrum,* Cirsium) and trees. Data from Arctic region are illustrated by the number of specimens cultured on dung from various herbivorous animals and beards. So, these substrata were collected also for study in laboratory. Decaying wood, bark and branches of different trees was collected also.

A total of 183 moist chamber experiments were carried out. Moist chamber cultures were prepared as described by Härkönen (1977a, 1981a) and Stephenson (1985, 1989). First results of experiments with moist chambers have shown a wider distribution on Taymyr of *Echinostelium minutum* de Bary and *Perichaena chrysosperma* (Currey) A.List.
These species are regularly registered from moist chambers on living bark of *Duschekia* and *Larix*, and are the most common corticulous species on Taymyr. Also in moist chambers are developing plasmodia species of *Physarales* (*Physarum*) and *Stemonitales* (*Comatricha, Paradiacheopsis*)..
The very dry period in July was not allowed to collect a lot of material in the field.
Most of the species were found on decaying wood, but some species (*Physarum cinereum, Perichaena vermicularis*) on the litter of grass in moist microhabitat near brooks.
We have registered some species of *Comatricha, Reticularia, Didymium, Physarum, Lycogala, Trichia, Perichaena, Mucilago* only. In spite of scanty field material we can suppose that in the studied locality there are enough microhabitats for the development of myxomycetes. This is confirmed by our observations on traces of plasmodia and by having collected a lot of sclerocia on rotten wood, bark and large branches of *Larix sibirica.*
The majority of myxomycetes found in Taymyr are species distributed throughout the northern boreal zone and no specific Arctic element has been found

6.6 Lichenological studies
(M. P. Zhurbenko)

The main reasons why studies of lichens are important in the complex studies of nature in the Arctic are as follows:
- lichens are one of the main component of plant cover of the Arctic ecosystems;

- in some respects they are a very sensitive component of the Arctic ecosystems (overgrazing with raindeers, disturbance with caterpillar transport, air pollution);
- they are well known tools for estimating the air pollution in a territory;
- like other plants they can provide evidencies of the natural history of a region.

Although the first scientific lichen collections on Taymyr Peninsula were performed long ago - in 1843, by expedition of A. T. Middendorff - the territory is still insufficiently explored lichenologically. Most of the collections have been made along the coast of the peninsula, while the central areas, particularly the Byrranga Mts are virtually unstudied. Our investigations in the region of Levinson-Lessing Lake and Bol'shaya Bootankaga river represent the second - after Ary-Mas - study of local lichen flora in the spacious territory of Taymyrskii Preserve. It is also the first original study of lichenicolous fungi in Russia.

Materials and methods

Lichen flora of the region of Levinson-Lessing Lake were examined during two field seasons (July - August) in 1994 and 1995. These studies were performed by usual methods of one-day radial transsects (5-15 km long) from the base camps at the northern end of the lake (mouth of Krasnaya river; 74°33 N, 98°35 E) and at its southern end (74°25 N, 98°48 E). Additional 7 - 10 days' routes were carried out along the Krasnaya river, to the middle course of the neighbouring Bol'shaya Bootankaga river (base camp - 74°30 N, 97°40 E; ca. 30 km W from the base camp at the mouth of Krasnaya river).

Lichens have been collected in all registered types of habitats within the landscape. Every type of habitat has been visited at least several times (the total number of such study sites is ca. 200). All lichens in a habitat from all types of substrate were collected (total number of specimens is more than 10 000, in ca. 1000 envelopes). Specimens are housed in the Komarov Botanical Institute.

Some species will be distributed to the Botanical Museums of Uppsala and Munich.

Specimens of the main dominant lichen species (*Asahinea chrysantha, Cetraria islandica, Cetrariella delisei, Cladina arbuscula, Dactylina Arctica, Flavocetraria cucullata, Flavocetraria nivalis*) have been collected for determination of the air pollution in the region of the mouth of Krasnaya river. These samples were collected from the top of the mountains (in stone fields and rocks at 350 - 400 m a.s.l.) and from the level of the river valley (50 m a.s.l.). *Cetraria laevigata* has been collected from the region of the settlement Khatanga (forest-tundra).

Preliminary results

The local lichen flora of the region of Levinson-Lessing Lake proved to be extremely rich in species diversity (expected total number of species should be not less than 400 - 500).

(Some results of studies made in 1994 are included in the following publications: Zhurbenko, M. P. (1996), Zhurbenko, M. P. & Santesson, R. (see chapter 10).

Most of the lichenicolous fungi (more than 30 species) and the following lichens found in the area are new to Russia, Siberia, or the northern Krasnoyarsk territory: *Acarospora rhizobola, Acarospora scabrida, Anaptychia ciliaris, Gyalecta kukriensis, Gypsoplaca sp. (probably a new taxa), Lecanora cavicola, Teloschistes contortuplicatus, Thelocarpon epibolum, Xanthoria* *borealis.*

A few lichen species which are possibly predominantly associated with the coastal Arctic areas occurred in the region - *Lecanora geophila, Sticta Arctica* (both species occur here and there at different altitudinal levels, mostly at the higher levels; *Sticta arctica* could be locally abundant) and *Siphula ceratites* (met only in two localities in the region of Krasnoe Lake, at the top of the mountains at 300 - 400 m a.s.l., in rather wet tundras, locally abundant).

Discussion

Richness of the lichen flora in the studied area could be well explained by the landscape diversity of the region, which combines also different types of rocks (particularly important in this respect are limestones). Though the flora of the whole examined area seems to be rather homogenous, some fluctuations in the species distribution has been clearly observed. Quite a number of species have been found only in one or a few localities, and have not been observed in the other similar types of habitats in the area.

Some species have been found only in the basin of the Bol'shaya Bootankaga river and were not registered in the vicinities of Levinson-Lessing Lake.

It is remarkable, that after the first year of intense field studies in the vicinities of the mouth of the Krasnaya river, we made additional findings in the local lichen flora in the second year of observation.

The reconstruction of plant cover by lichens becomes difficult due to long possible distance transport of lichen diaspores, especially when considering the absence of supports from fossil lichens.

Nevertheless, if one assumes that lichen distribution patterns are mostly associated with step-wise dispersal and determined historically, they could well be interpreted in the frame of the general biogeographic history of an area. Thus, the occurrence of the afore-named coastal Arctic species in the inland areas of the Taymyr Peninsula fits well into the notion of the transgressions in this region.

Prospects

Further investigations of the lichen flora of the region of Levinson-Lessing Lake - Bol'shaya Bootankaga river (west of Taymyr Lake) could provide fundamental knowledge of a reference mountain lichen flora of central Taymyr in the transitional zone between typical and Arctic tundras.

These studies combined with the started complex studies of the other components of the regional biota (soil and rust fungi, vascular plants etc.) fill existing gaps in knowledge of the nature of the Taymyrskii Preserve, Byrranga Mts and Taymyr - Severnaya Zemlya region as a whole.

This will also provide a significant contribution to the understanding of the Panarctic biota - a project now being promoted in many countries.

6.7 Soil micromycetes
(M. P. Zhurbenko and I. Kirtciteli)

Soil micromycetes are a compulsory share of any biocenoses in the Arctic. They take part in the formation of gumus, destruction of plant remains and influence the conditions of plant life.

Samples of soil for mycological analyses were selected with standard methods at the micromycetes' peak of activity under sterile conditions regarding the paper bags (typ "Kraft"). 10 repeatable soil samples were

collected from the upper soil horizon.
Soil samples were collected on the Taymyr peninsula in a typical tundra near Lake Levinson-Lessing in 1994, in the Arctic tundra near the settlement Dickson in 1995, and in the Arctic desert on a number of islands of the Severnaya Zemlya archipelago in 1995 year.
Soil micromycetes from the basic biocenoses were investigated. The number, the biomass, and the structure of complexes and the productivity of micromycetes (including phytotoxis, celluse destructions) had been studied.
The number of micromycetes oscillated from several tens to several thousands of germs (colony forming units) in 1 g of soil. From the Arctic desert to typical tundra there was a marked increase in the number of soil micromycetes.
All characteristics of mycelium biomass obtained generally are typical for a very poor soil. Mycelium biomass increases from Artic deserts to typical tundra. Soil fungal communities in typical tundra consist of 65 species, among whichmicromycetes of the genus penicillium predominate. Comparison of micromycetes complexes by cluster analysis was made. It showed that the type of soil and biocenoses render essential influence on the number of micromycetes in soil, but resemblance in complexes of micromycetes remains on high level. Severe conditions in the typical Arctic tyndra cause the poverty of species in soil micromycetes and form small groups of species typical for this territory.
Species diversity as shown by Shennon definitely decreases from the typical tundra to the Arctic desert.

7 HYDROLOGICAL STUDIES

7.1 Processes in the water column of the Levinson-Lessing Lake (B. Hagedorn, J. Boike, D.A. Gintz and V. Mescherjakov)

7.1.1 Introduction

This study focuses on recent sedimentation processes in the Levinson-Lessing Lake.

Lacustrine sediment sequences are suitable archives to reconstruct the paleoenvironmental development. The deposition of lacustrine sediments is controlled by a number of interacting physico-chemical processes. Their relative importance depends on the climatic conditions, morphological and geological features of the catchment area, the shape and the size of the lake basin and its orientation as well as the hydrological setting of the lake water body (Sly, 1978). To reconstruct paleoenvironmental evolution by lake sediments the sedimentation processes under present conditions should be considered.

The objective is to: 1) record the sedimentation in the lake and 2) determine the sources of the sediments. Therefore, sediment flux in the lake water body and "near surface" cores as well as sediment load in the river inflows were investigated applying hydrological, geochemical, radiochemical (^{210}Pb) and sedimentological methods.

The Levinson-Lessing Lake is an oblong north to south trending, up to 100 m deep, V-shaped basin located in the Byrranga Paleozoic fold system near the 74° latitude. Main in- and outflow are the Krasnaya river in the north and the Protochnyi river in the south, respectively. Additionally, more than 20 small streams contribute water and sediments to the lake. The high relief of the catchment area (up to 570 m) causes fluctuating sediment inputs with strong peaks during snowmelt and intensive rainfall (Bolshiyanov & Anisimov, 1995).

7.1.2 Field work

From June 1995 to October 1995 water profiles, suspended material of three small stream inflows and the Krasnaja river (see chapter 7.2), particulate matter in the water column as well as "near surface" sediment cores (gravity coring up to 30 cm depth; see chapter 8.1.) were sampled in the northern part of the lake (sampling sites are presented in Figure 7-1). The lake water was collected with an 5 l water sampler. From June to July sampling was accomplished from the 2 m thick ice cover. From 13 to 25 July the ice cover became unstable and work on the lake was impossible. At the end of July, when the ice cover was completely thawed, sampling was carried out from an inflatable dinghy. Measurements of water depths were carried out with an 100 m long nylon string with markers every 5 m and with an echolote. For both methods an error of 5 m was estimated.

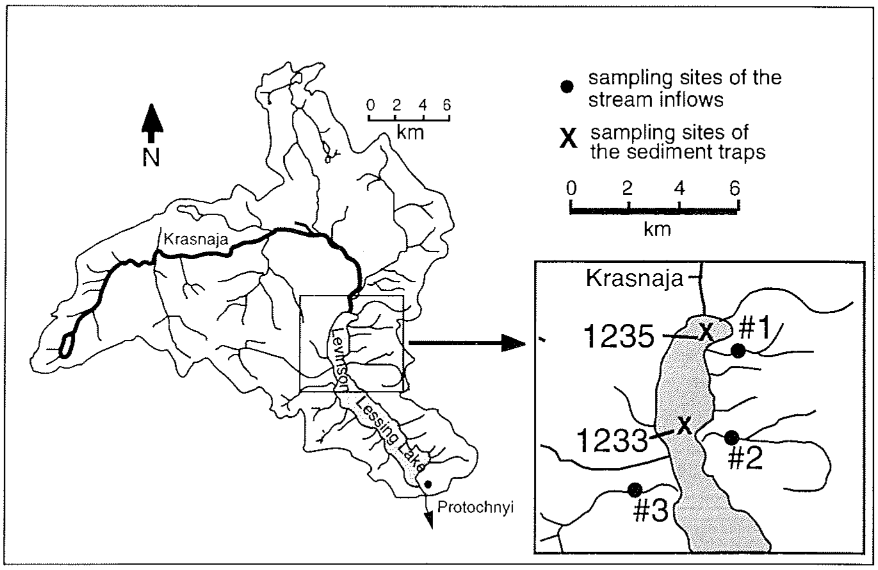


Fig. 7-1: Catchment area of the Levinson -Lessing Lake and sampling locations

To record the sediment flux in various depths of the water column, sediment traps (borrowed from the Institute of Freshwater Ecology and Fisheries; Department: Limnology of Shallow Waters, Berlin, Germany) were installed close to the coring sites 1235 in 500 m distance to the Krasnaja delta and 1233 in 3,5 km distance to the Krasnaya delta (Fig. 7-1). The traps were placed in 25m and 45m water depth at site 1235 (50 m water column) and 20m, 44m, 55m, and 66m water depths at site 1233 (70 m water column) and sampled continuously from June to October. The trapped sediments were filtered with cellulose acetate filters (CAF) of 0,45 µm pore size and air dried. A schematic illustration of the traps is presented in Figure 7-2.

To estimate the ^{210}Pb-flux in the water column as well as the residence times of the particulate matter, water samples of 20 l were filtered (CAF ; 0,45 µm) and spiked with a ^{208}Po-tracer and 10 µg of common Pb for determining the chemical yield. The 20 l samples were then concentrated to 250 ml by precipitation with a $FeCl_3$ -solution. The filter were air dried and stored in plastic boxes. To estimate the atmospheric ^{210}Pb-flux, 5 to 20 l water samples of precipitation (snow / rain), ice, as well as soil water were processed by the same procedure. Hydrochemical investigations of pH and electrical conductivity were carried out on water depth profiles in the lake using WTW (Wissenschaftlich-Technische Werkstätten GmbH, Weilheim) instruments. The pH electrode was calibrated with a pH 4.00, 7.00 and 10.00 solution prior to every measurement.

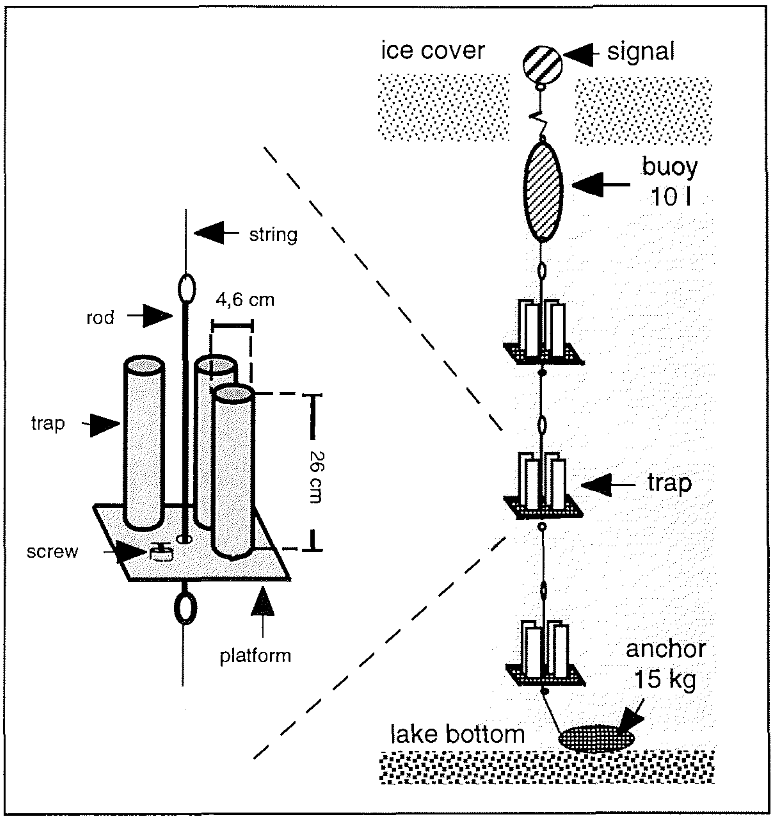


Fig. 7-2: Schematic illustration of the sediment traps installed in the Levinson-Lessing Lake

To investigate sediment load of the four rivers, water samples of 1 to 5 l were filtered (CAF; 0,45 µm). Lake water, river water as well as snow and ice (between 30 ml and 1 l) were sampled and filtered for chemical and stable isotope analyses.

7.1.3 First results

Hydrochemical measurements in the lake water column indicate uniform values of a pH of 7 - 8 and an electrical conductivity of 50 - 60 µS/cm. The temperature was homogeneous and changed from 1°C in June to 4°C at the end of July and decreased to 2 °C in October (Tab. 7-1)

The suspended sediment concentration in the lake water column sampled with the water sampler was between 0,5 and 3,2 mg/l. The sediment load of the three little streams sampled at the 24.06.1995 and 07.07.1995 ranged from 160 mg/l to 3 mg/l, where the high load of sediments was related to snowmelt at this days.

Table 7-1: Hydrochemical measurements of the lake water column at location 1235 and 1233 (see Fig. 7-1)

locality	water depth (m)	date	conductivity (μS/cm)	pH (-)	temperature (°C)
1233	0,0	16.06.1995	2	-	-
1233	2,5	16.06.1995	40	8	0,9
1233	25,0	16.06.1995	54	7,9	0,9
1233	50,0	16.06.1995	54	7,7	1,2
1233	70,0	16.06.1995	54	7,6	1,1
1233	2,5	25.06.1995	22	7,1	0,6
1233	25,0	25.06.1995	54	7,4	1,1
1233	60,0	25.06.1995	53	7,5	1,3
1233	2,5	08.07.1995	22	7,1	-
1233	25,0	08.07.1995	54	7,4	-
1233	60,0	08.07.1995	53	7,5	-
1233	0,0	13.07.1995	2	-	0,2
1233	2,5	13.07.1995	15	-	0,8
1233	25,0	13.07.1995	53	-	1,2
1233	60,0	13.07.1995	53	-	1,2
1233	2,5	22.08.1995	-	-	3,4
1233	25,0	22.08.1995	-	-	3,2
1233	60,0	22.08.1995	-	-	3,1
1233	2,0	25.09.1995	56	7,1	2,4
1233	25,0	25.09.1995	57	7,4	2,6
1233	50,0	25.09.1995	58	7,3	2,6
1233	65,0	25.09.1995	57	7,2	2,7
1235	2,5	11.06.1995	39	7,3	1,7
1235	10,0	11.06.1995	54	-	1,1
1235	15,0	11.06.1995	50	-	0,6
1235	20,0	11.06.1995	55	-	0,5
1235	25,0	11.06.1995	57	7,6	0,6
1235	30,0	11.06.1995	57	-	0,6
1235	35,0	11.06.1995	57	-	0,6
1235	40,0	11.06.1995	57	7,5	0,6
1235	48,0	11.06.1995	57	-	0,6
1235	2,5	13.06.1995	38	7,3	2,1
1235	25,0	13.06.1995	55	8	1,6
1235	40,0	13.06.1995	-	8,1	-
1235	48,0	13.06.1995	56	-	1,4

locality	water depth (m)	date	conductivity (μS/cm)	pH (-)	temperature (°C)
1235	0,0	25.06.1995	1	6	1,2
1235	2,5	25.06.1995	28	7,5	-
1235	25,0	25.06.1995	55	7,8	-
1235	48,0	25.06.1995	55	7,8	-
1235	0,0	03.07.1995	2	-	0,9
1235	2,5	03.07.1995	49	7,3	1,1
1235	20,0	03.07.1995	54	7,4	0,95
1235	40,0	03.07.1995	54	7,6	1,1
1235	2,0	28.07.1995	54	7,6	4,2
1235	20,0	28.07.1995	54	7,9	3,9
1235	44,0	28.07.1995	55	7,9	3,8
1235	2,0	10.08.1995	55	7,1	3,1
1235	20,0	10.08.1995	55	7,5	2,8
1235	40,0	10.08.1995	55	7,7	2,7
1235	2,0	21.08.1995	55	7,7	3,5
1235	20,0	21.08.1995	55	7,7	3,2
1235	40,0	21.08.1995	56	7,5	3,1
1235	2,0	16.09.1995	59	7,6	2,1
1235	20,0	16.09.1995	59	7,6	2,1
1235	40,0	16.09.1995	59	7,6	2,1
1235	2,0	23.09.1995	59	6,9	2,6
1235	20,0	23.09.1995	58	7,1	2,8
1235	40,0	23.09.1995	58	7,1	2,8
1235	2,0	30.09.1995	58	7,4	2,2
1235	20,0	30.09.1995	57	7,5	2,4
1235	40,0	30.09.1995	57	7,5	2,3

Table 7-2: Collected sediments with the sediment traps at location 1233 (for sampling locations see Fig. 7-1)

No.	sample no./ drill-hole	coordinates N/E	date in - out	ice cover in - out (m)	water depth (m)	sediment (g)
1	SB 1/1233	N:74°30,371	28.6.-2.7.	1,61 - 1,45	14,9	0,0166
2		E:98°35,532			40,7	0,0228
3					66,5	0,2758
4	SB 2/1233	N:74°30,371	2.7.-27.7.	1,45-0	20,6	0,1830
5		E:98°35,532			44,2	0,2824
6					55,4	0,4937
7					66,1	2,2662
8	SB 3/1233	N:74°30,371	27.7.-2.8.	0	20,6	0,2091
9		E:98°35,532			44,2	0,2132
10					55,4	0,2103
11					66,1	0,2247
12	SB 4/1233	N:74°30,371	2.8.-22.8.	0	20,6	0,5702
13		E:98°35,532			44,2	0,7037
14					55,4	0,5476
15					66,1	0,8079
16	SB 5/1233	N:74°30,371	22.8.-28.8.	0	20,6	0,0822
17		E:98°35,532			44,2	0,0963
18					55,4	0,0881
19					66,1	0,3696
20	SB 2/1232	N:74°30,410	2.7.-8.7.	1,38 - 1,17	9,8	0,0293
21		E:98°35,765			35,6	0,0681
22					61,4	0,2658

The results of sediment trap measurements demonstrate depth and season dependend variations of sediment fluxes in the lake water body (Tab. 7-2 and 7-3). Over the whole sampling period the sediment flux observed near the lake bottom is some orders higher than in the water column above. Maximal sediment accumulation was observed during July and August when the ice cover was thawn. From August to October only the traps at site 1235 were sampled. During this period the sediment accumulation rates decreased to the values observed under the ice cover in June. During the whole sampling period the total trapped sediment masses are 150 mg/cm^2 at site 1233 in 66 m water depths and 3000 mg/cm^2 at site 1235 in 45 m water depth near the Krasnaya delta.

Table 7-3: Collected sediments with the sediment traps at location 1235 (for sampling locations see Fig. 7-1)

No.	sample no./ drill-hole	coordinates N/E	date in - out	ice cover in - out (m)	water depth (m)	sediment (g)
23	**SA 1/1235**	N:74°31,804	15.6.-25.6.	2,00 - 1,50	25,0	0,2111
24		E:98°36,700			45,0	0,5410
25	**SA 2/1235a**	N:74°31,804	25.6.-29.6.	1,67 - 1,29	25,0	0,0359
26		E:98°36,700			45,0	18,5207
27	**SA 3/1235**	N:74°31,804	29.6.-27.7.	1,27 - 0,00	25,0	0,3440
28		E:98°36,700			45,0	28,5795
29	**SA 3/1235a**	N:74°31,804	3.7.-9.7.	1,33 - 1,15	13,2	0,0147
30		E:98°36,700			24,4	0,0137
31					35,1	0,0127
32	**SA 4/1235**	N:74°31,804	27.7.-2.8.	1,15	25,0	0,2888
33		E:98°36,700			45,0	1,1736
34	**SA 5/1235**	N:74°31,804	2.8.-9.8.	0	25,0	0,1734
35		E:98°36,700			45,0	4,1819
36	**SA 6/1235**	N:74°31,804	9.8.-21.8.	0	25,0	0,4122
37		E:98°36,700			45,0	1,0196
38	**SA 7/1235**	N:74°31,804	21.8.-28.8.	0	25,0	
39		E:98°36,700			45,0	
40	**SA 8/1235**	N:74°31,804	28.8.-16.9.	0	24,2	0,3110
41		E:98°36,700			35,4	0,4599
42					46,1	0,3976
43	**SA 9/1235**	N:74°31,804	16.9.-23.9.	0	24,2	0,0750
44		E:98°36,700			35,4	
45					46,1	0,0864
46	**SA 10/1235**	N:74°31,804	23.9.-30.10.	0	24,2	0,0418
47		E:98°36,700			35,4	0,0438
48					46,1	0,0478
49	**SA 11/1235**	N:74°31,804	30.10-7.10	0	24,2	0,0134
50		E:98°36,700			35,4	0,0313
51					46,1	0,0394

7.2 Hydrological Investigations at the Krasnaja River (D.A. Gintz, V. Mescherjakov, H. Becker, J. Boike and B. Hagedorn)

7.2.1 Methods

In the Krasnaja river hydrological parameters were measured during a period of approximately four and a half month. The measurements started with the snowmelt in June (9.6.1995) and ended in early October (8.10.1995).

The following parameter's were observed:

- water level recording
- water velocity
- pH-values
- electric conductivity
- water temperature
- suspended sediment concentration

7.2.1.1 Measurement of water discharge

The gauging station was installed on June 6th. The snow and ice cover of the Krasnaja river prevented an earlier installation. The location of the gauging station was about 500 meter above the river delta at the Levinson-Lessing Lake. The calculation of water discharge was based on automatic water level recording (Seba) and correspondent flow velocity measurements with an Ott-propeller.

The Krasnaja river is a typical braided river. At the measuring profile the river bed was divided into two small and one main channel. To measure the flow velocity in the main channel it was necessary to use a small boot. Up to Q = 16 m^3s^{-1}, the discharge was concentrated in the main channel on the right side, which was about 40 meter width. Above this level the river bed extended to a maximum width of approximately 150 meters.

7.2.1.2 Measurements of electric conductivity, temperature and pH -values

The measuring station was equipped with a datalogger for continuous recording of electric conductivity, water temperature and pH-values. Each probe was installed on a float in the middle of the main channel. The measured values, excluding the pH-values, were recorded from June 15th to August 31st in a time-interval of one hour. Due to technical problems with the probe, pH-measurements could only be recorded from June 15th to July 3rd. Since the Datalogger was only available up to September 1st, the further measurements of electric conductivity and temperature, up to October 8th, had to be taken manually, three times a day.

7.2.1.3 Suspended sediment sampling

The samples for suspended sediment concentration were collected in the same cross profile. With a multiple point-sampler samples of one litre were collected manually from the boat. In the vertical profile three one litre samples in 5, 25 and 40 cm above ground were taken at the same time. In addition, at high water levels the small channels were also sampled. The collected water samples were filtered with cellulose acetate (CAF) filters with a pore size of 0,45 µm, and after that air-dried.

7.2.2 Preliminary results

7.2.2.1 Water level, water velocity, discharge

In a first period of water level recording (until July 13th), the daily oscillations of the water level were generated by snowmelt water. The differences of the fluctuations in the water level ranged between 5 and 35 cm. The daily flood wave reached the peak around midnight, and lowest level was about noon time.

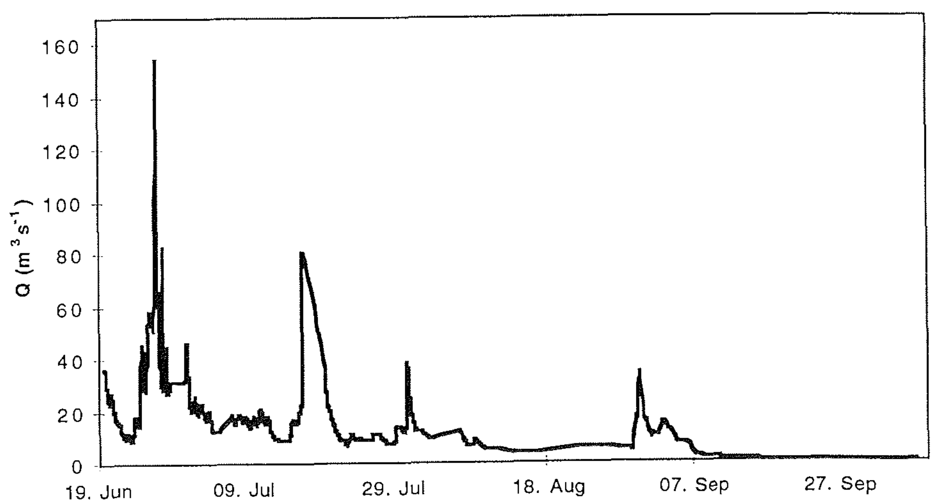


Fig. 7-3: Hydrograph of Krasnaja river in summer 1995

A first high peak (Q = 153 m^3s^{-1}) in the hydrograph (see Fig. 7-3; Tab. 7-4) was caused by snow melt, which occurred after some days with very high radiation. The following peak's after the snowmelt period were caused by different precipitation events.

Table 7-4: Discharge, maximum and average water velocity in the Krasnaja river at some flood events

Date	Q (m^3s^{-1})	v max. (ms^{-1})	v average (ms^{-1})
21. Jun	21.80	1.32	0.92
27. Jun	153.4	-	-
09. Jul	17.60	1.22	0.71
17. Jul	25.00	1.52	0.86
23. Jul	9.30	1.11	0.35
31. Jul	38.00	1.73	0.62
04. Aug	65.40	1.87	0.79
10. Aug	4.80	1.00	0.28
23. Aug	6.30	1.04	0.37
05. Okt	0.02	-	-

7.2.2.2 Electric conductivity, pH- values and water temperature

The values of electric conductivity in the Krasnaja river vary in a wide range, from 12 to 160 µS. In the early time of recording, until the end of snowmelt, the electric conductivity values were almost of the same magnitude, and varied from 12 to 36 µS. Owing to the dilution effect of high discharge, the expected inverse correlation between electric conductivity and discharge was observed (see Fig. 7-4). After this snowmelt period a continuous increase of the electric conductivity values occurred. This increase was only interrupted by the dilution effect of flood waves generated by single precipitation events that lead to a decrease in electric conductivity values.

The pH-values oscillates around pH 7.0, and ranged between pH 6.3 to 7.8. There is a weak correlation between discharge and pH-values. However for discharge below 40 m^3s^{-1} the pH-values are slightly above pH 7.0 up to pH 7.8, and for discharge above 40 m^3s^{-1} the water is slightly acidic.

The water temperature varied in a daily rhythm, with lowest temperatures in the early morning hours. Daily warm up of the water temperature was about 5.0 to 6.0 degrees Celsius. In general, the daily average temperature increased from 0.0 °C to 11.0 °C to the end of July. After this period the average temperature values had a tendency to decrease.

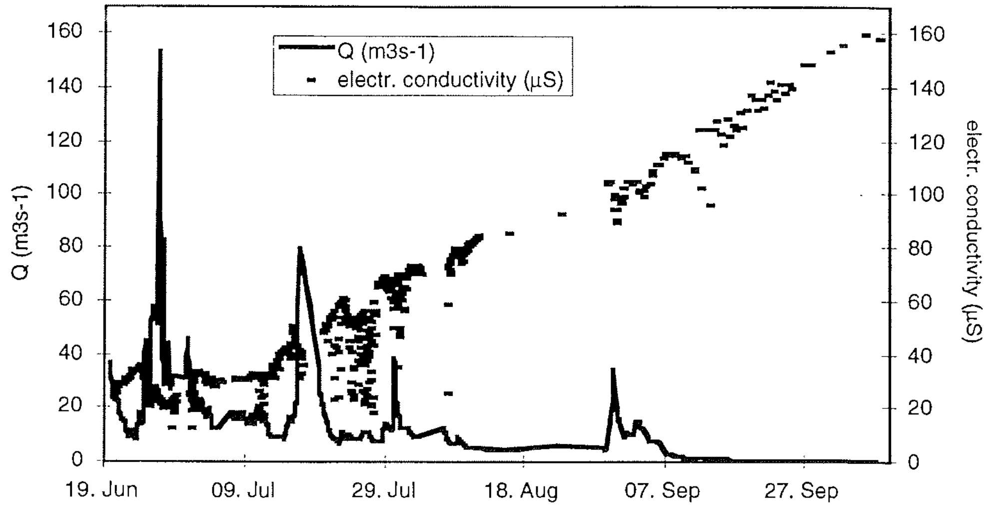


Figure 7-4: Hydrograph and electric conductivity of Krasnaja river in summer 1995

7.2.3.3 Suspended sediment concentration

There is a wide variation in the average suspended sediment concentration in the Krasnaja river, due to different discharge from 0.02 g/l up to 0.60 g/l. Further a difference in suspended sediment concentration was observed, in the cross profile as well as in the vertical profile at the same discharge. During low discharge the suspended sediment was distributed almost homogeneously in the cross profile, with average values between 0.02 g/l to 0.05 g/l. At higher discharge the diversity of the suspended sediment values increased in the cross profile. For example, at a discharge of 52 m^3s^{-1} the values ranged from 0.20 g/l at 10 m channel width to 0.29 g/l at 25 m and 0.55 g/l at 48 m, and at a discharge of 67.5 m^3s^{-1} the values ranged from 0.22 g/l in 15 m to 0.49 g/l in 25 m and 0.95 g/l in 63m to 0.65 g/l in 138 m channel width.

7.3 Active layer hydrology

(J. Boike, P. P. Overduin, B. Hagedorn, D. Gintz and U. Salzwedel)

Since 1994 a study on water and solute movement has been undertaken at Levinson-Lessing Lake, Taymyr Peninsula, Siberia, to identify water movement in the vadose and phreatic zones of the active layer (Boike *et al.*, 1995). The objective is to study flowpaths of water in the active layer for one continuous cycle of thawing and refreezing as it is illustrated in Fig. 7-5. Furthermore, the hydrological response of the active layer to spring snowmelt and summer precipitation events is studied under a variety of geomorphological settings within the lake watershed.

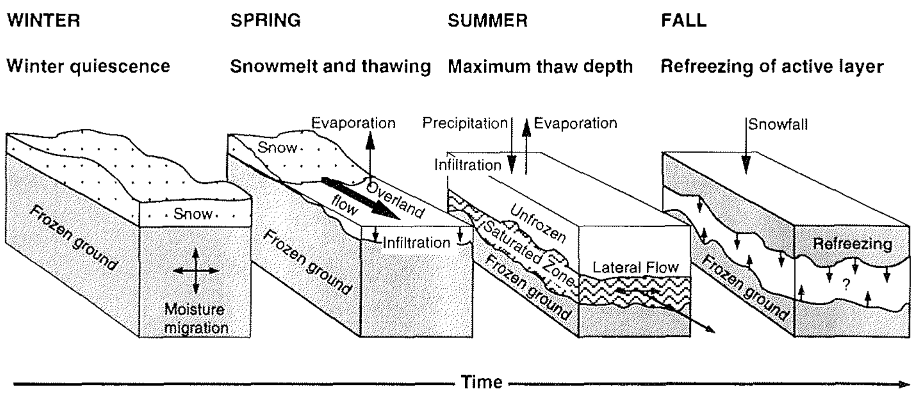


Fig.7-5: Hydrological processes in the active layer from spring to fall

Three slopes differing in parent material, aspect, inclination, vegetation and thaw depth of the active layer have been instrumented and studied during the summer in 1994. Methods and first results are reported in Boike *et al.*, 1995.
Field work continued in 1995 from 3 June to 15 October which included the times of snowmelt and fall freeze back. As in 1994, soil temperatures, soil water volumetric content and bulk electrical conductivity were measured. Water samples were taken from the phreatic and vadose zone, precipitation and frozen soil for the analysis of electrical conductivity, pH and stable isotopes (Annex 11.1-7).
Two climate stations (located in the Krasnaja floodplain and on one adjacent slope) continuoulsy recorded data in 15 minute intervals from June to October. In addition, an automatic station was installed at one profile to measure soil moisture and temperatures every fourth hour.
Dye tracer tests using Brilliant Blue FCF were carried out to identify the nature of water flow within the active layer.

First data of 1995 suggest that water in the active layer is routed along preferential flowpaths rather than forming a saturated zone above the frost table. This is also supported by dye tracer tests.

7.4 Hydrological observations at the Upper Taymyra and Logata rivers (V. Zimitchev)

The hydrology of the Upper Taymyra river and its main tributaries has been rather poorly investigated up to now. These studies were mainly physical-geographical descriptions of the objects on the whole or single separate measurements which actually do not provide an understanding of the runoff dynamics of these rivers.
The aim of the full-scale studies carried out in 1995 was to obtain primary hydrological information which could allow qualitative and quantitative estimates of the water flows under study, namely, - water runoff, discharge of sediments, suspended matter, dynamics of channel deformations, estimates of water-balance components at the scales of the water catchment areas of the

water-balance components at the scales of the water catchment areas of the Lower Taymyra river and Taymyr Lake. For this purpose during the prespring, spring and summer periods from June to August, observations at two river sections - the upper Taymyra and Logata were organized (Fig. 7-6).

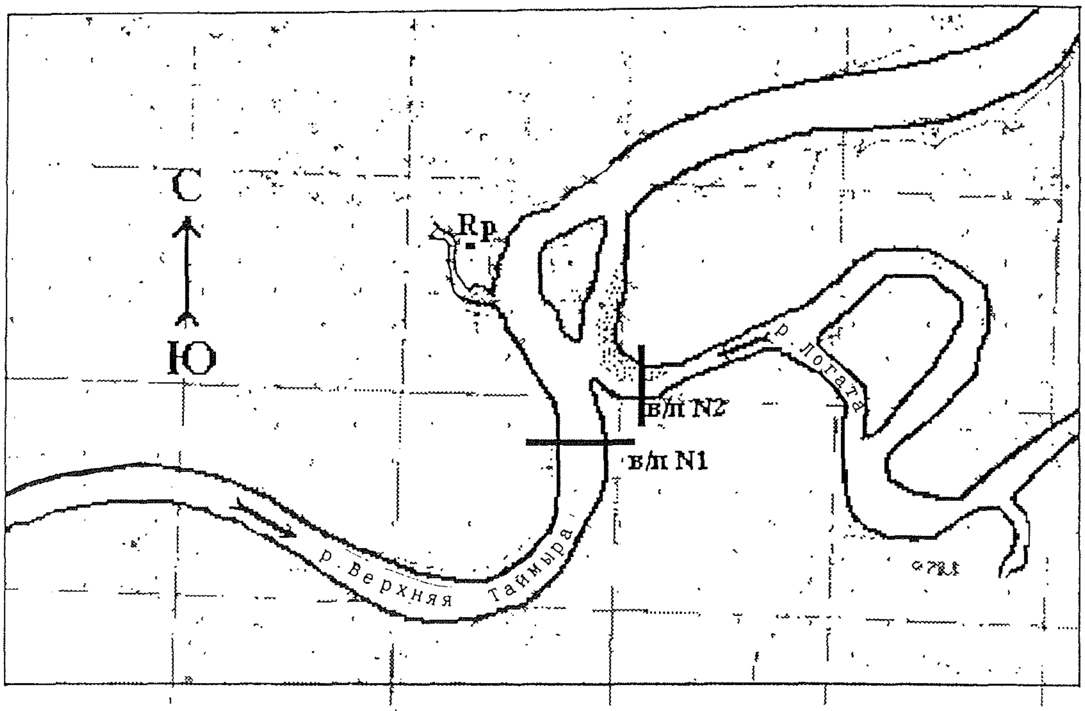


Fig. 7-6: A scheme of location of the water gauges and hydrological sections at the Upper Taymyra and Logata rivers

Observations were commenced during the prespring low water in early June. The ice thickness varied within 1.7 to 1.9 m based on measurements at each of the sections. The snow cover depth at the rivers at this time was, on average, about 0.5-0.6 m.

The first ice debacle, occurs as a rule, at the Taymyra tributaries. At the Logata river ice break-up is observed on June 15-18. At first, ice disappears in the lower current of the river on the segment of 20-30 km. Then for 3-4 days there is a further increase of the water level in the river, after which there is a very active ice movement occurring for several 10-15 hours. During the season of 1995 the ice movement was very intense. This was expressed in the dynamic disintegration of medium ice floes, large rubble of ice floes on the river shores, in large pieces of turf sagging from the last year being turned out. In the zone of the confluence with the Upper Taymyra along fast ice on the right-hand side, an ice inflow upstream the river over more than 1 km was observed.

After the passage of the main ice mass, the motion of separate ice floes along the midstream is observed for 2-3 days. Then the river becomes completely ice free. During the 1995 season the ice movement in the Logata river continued

for 7 days.
At the upper Taymyra the ice movement begins 3-4 days later than in its tributaries. The dynamics of the ice drift is smooth. The erosion activity of ice is expressed much weaker than at Logata. In 1995 the ice movement at the upper Taymyra began on June 21 and ended on June 30.
The date of the onset of the ice movement depends on climatic conditions of the spring period. In 1995 the spring was quite cold and long (Fig. 7-7). Mean air temperature in June was about 5°C and only several times it exceeded 10° C. Due to this, the duration of snow melting was extended in time which in turn slowed the increase in water levels and the ice movement began 3-4 days later, than is usually observed at these rivers.

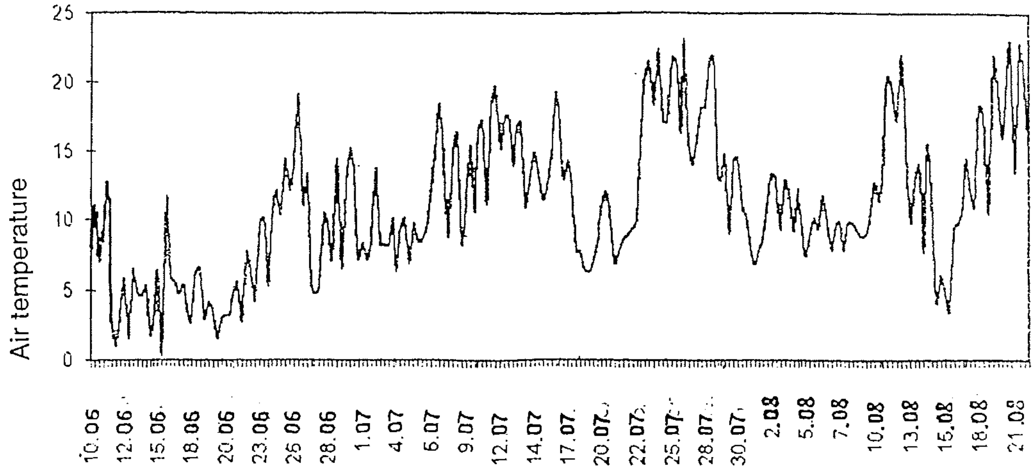


Fig. 7-7: Air temperature variability in the region of water gauges over June-August 1995

In July-August 1995 the air temperature was above the norm which influenced the dynamics of melting of permafrost ground, runoff of ground water and the regime of river levels. Also, an important climatic feature of this season was a rather low amount of precipitation as compared to the multiyear mean.
Compared to small water flows of central Taymyr (for example, the Krasnaya river), the thermal regime of medium and large rivers does not show any dynamics within one day (Fig. 7-8). The water temperature in the Taymyr and Logata changes smoothly and has quite an inertial character with respect to air temperature characteristics responding to weather changes during 4-5 days.
In the Logata river the water temperature is, as a rule, 2-3° C higher than in the Taymyr river. This can be attributed to the influence of the increased turbidity of the Logata river flow, as well as a to a smaller volume of the channel and its large length in the direction from south to north. These are additional conditions for better water warming.

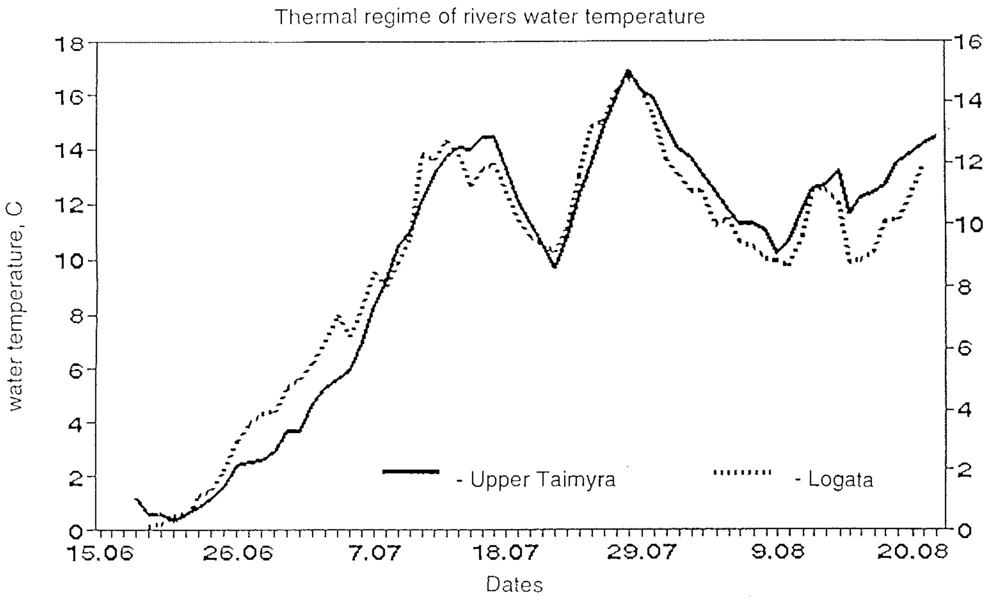


Fig. 7-8: Thermal regime of river water temperature (^{0}C) - Upper Taymyra - Logata

In prespring time in the ice cover presence on the river, the water temperature varies around zero values, not exceeding 1-2° C. The maximum water warming in Logata was observed in August (17° C), and Taymyra was heated up to 15° C.
In other periods, in particular, at the end of the second 10-day period of August, the water temperature in Taymyra was 1-2° C higher than that in Logata. This time coincides with active solifluction processes on the shores of the Upper Taymyra and the increased turbidity of the river flow which, probably, was the cause for more active water heating.
Special attention in studies of the rivers under consideration was given to observations of the level regime, water runoff and discharge of sediments. Levels observations at each of the water gauges were performed twice a day. Relative marks of sectional staff gauges based on the gauge datum of GUGMS were recalculated to the absolute marks of the Baltic System.
The dynamics of levels at both rivers is quite synchronous (Fig. 7-9) which is attributed to a close hydraulic relation of the observation sections located not far from their confluence. The amplitude of level oscillations relative to the low water period is quite large - not less than 9 m. Maximum levels are observed at the time of the end of the ice drift. At these levels the channel section is completely flooded. Through separate depressions water floods quite significant areas of interfluvials with lakes and eriks (up to several km^2).

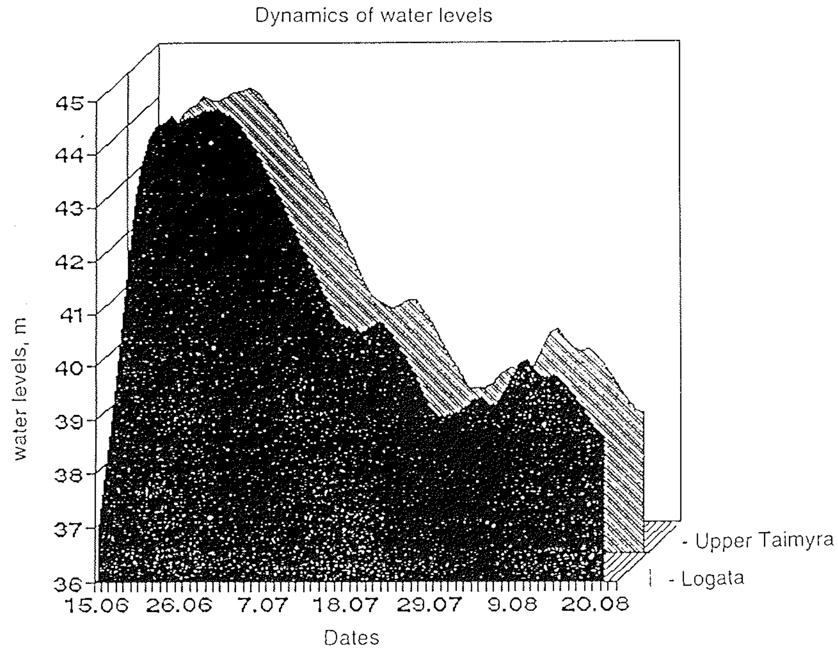


Fig. 7-9: Dynamics of water levels

The rise of the river levels occurs for 12-15 days. The intensity of the rise and duration of maximum levels is governed by the weather character in the spring period. During the 1995 season according to the estimates of local fishermen, the period of the rise of levels lasted for 2-3 days and high water levels persisted 5-7 days longer. This, in turn, influenced the increase in the volume of water and sediment discharge for the flood period.

The sum of positive temperatures of the summer period governs the dynamics of the levels of summer low water which in turn, depends on the dynamics of melting of permafrost ground and the amount of rainfall. The highest water level rise in Taymyra and Logata was observed in the middle of August when the largest soil heating and an active runoff of permafrost water coincided with the period of rain. The level rise was more than 1 m.

Observations of water runoff in the study rivers were based on two sections (Fig. 7-6). Measurements uniformly covered all phases of the hydrological regime of the prespring, spring and summer periods. During the autumn low water the fraction of river runoff is insignificant. Hence, the observed period provides practically almost complete information on the runoff regime (Fig. 7-10).

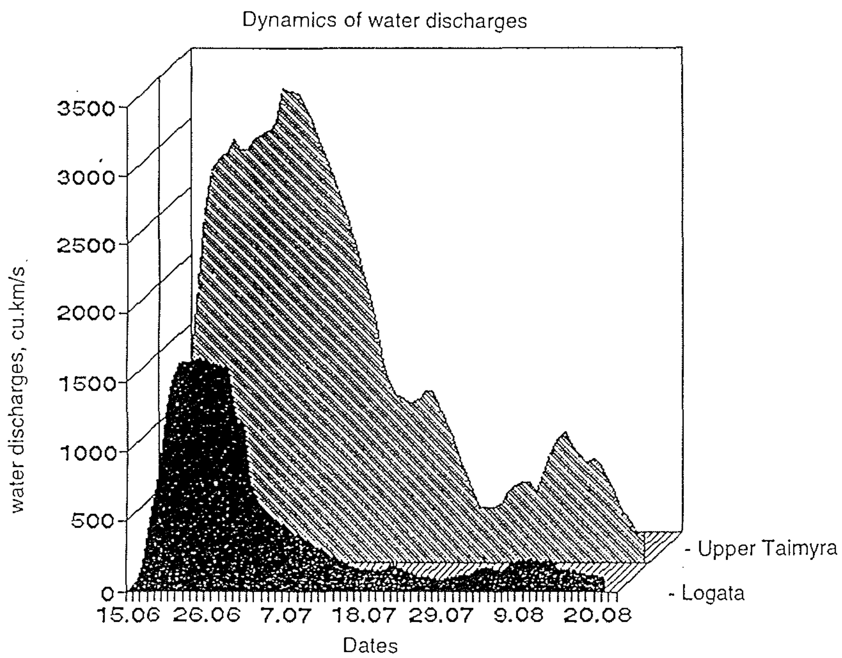


Fig. 7-10: Dynamics of water discharge (km^3/s)

The total number of measured discharges at the Upper Taymyra is 13, at the Logata - 15. Measurements were conducted (except during the ice movement period) not less than at 5 verticals in a detailed way. During the ice movement 2-3 verticals at the section were determined using different methods. Subsequently all verticals were fixed in the channel by buoys.

The section of the Taymyra channel in the studied section has a slightly asymmetric V-shaped form with a more gently sloping left shore and a steep precipitous right shore.

Depending on the phase of the hydrological regime, the flow axis shifts by about 50 meters. The width of the channel flow at the flood peak reaches more than 450 m with depths up to 18 m. The low plain on the left shore, overgrown with shrub, is flooded over 50-70 m.

The channel of the Logata river in the observation section has an asymmetric form with a gently sloping right-hand shore and the dead space near the left-hand shore. The dynamical axis of the flow shifts depending on the regime phase.

During the maximum levels it is situated closer to the right-hand shore and near the left shore there is the dead space, sometimes a weak reverse current near the shore. At low levels the dynamic axis of the flow shifts to the left shore. The width of the channel during the flood reaches more than 300 m with depths up to 16 m. At the time of freeze-up the width decreases more than twice.

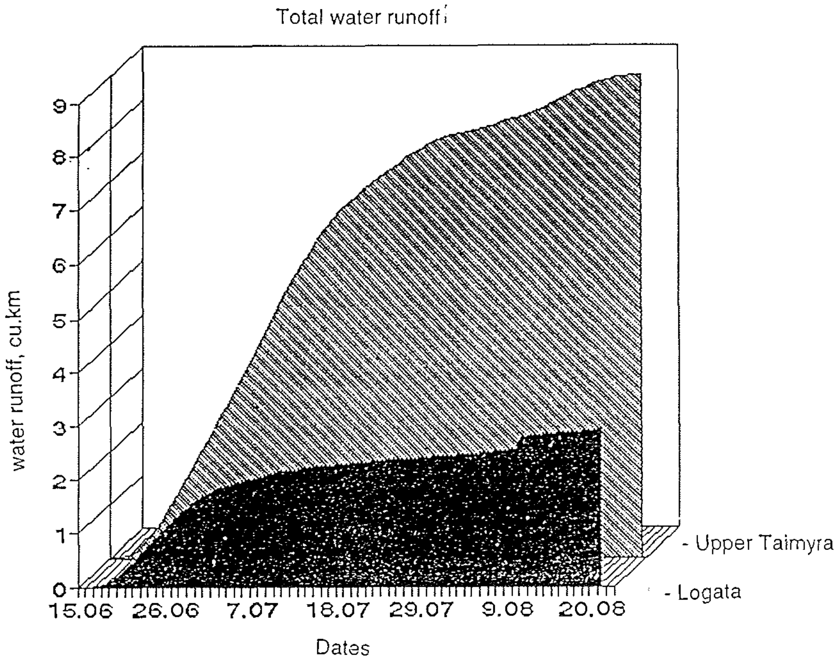


Fig. 7-11: Total water runoff (km^3)

The variability range of water discharges at the Upper Taymyra varies from zero values in the wintertime up to 35 000 m^3/s at the passage of the flood wave (for 1995). The main portion of the water runoff passes before the middle of July. The total runoff for the observed period was about 9 km^3 (Fig. 7-11). The Q(H) dependence (Fig. 7-12) has a loop-shaped form, the rise branch being located here on the left which is attributed to the presence of a small affluent from the side of the fall of the Logata river below the section of measurements. Due to this feature, the maximum water discharges at a given section are observed during the first days after the onset of the flood drop.

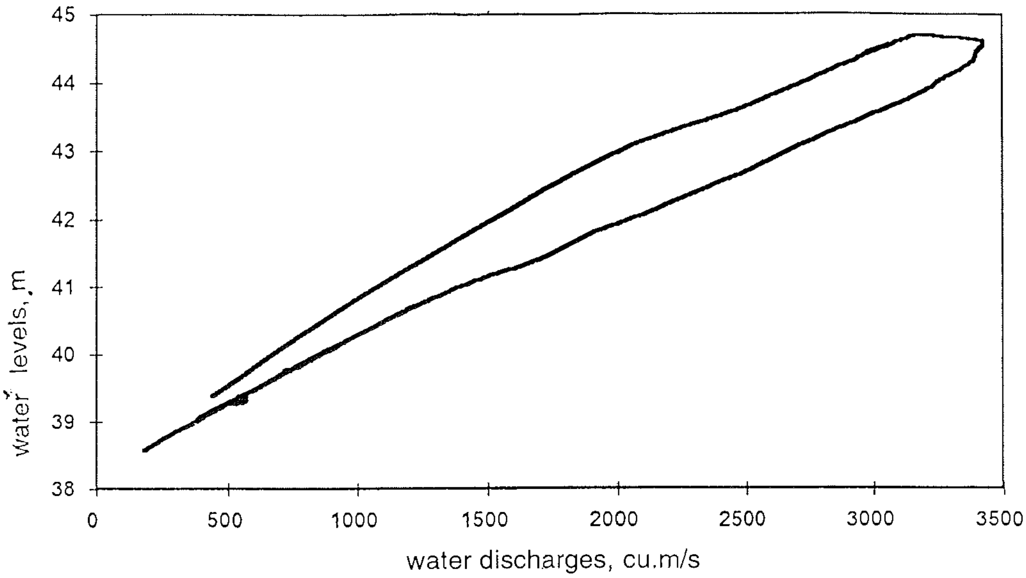


Fig. 7-12: The Q(H) depedence for Upper Taymyra river

For the Logata river the Q(H) dependence (Fig. 7-13) has a loop-like dependence with the largest discharges at the branch of the rise of levels which were observed at the ice movement. The right-hand side of the rise of water levels considerably deviates here from the drop branch. During the 1995 season the largest water discharges here reached about 1700 m^3/s.
The total water runoff in Logata for the 1995 observation period was about 3 km^3, i.e. about 30% of the runoff of the Upper Taymyra (Fig. 7-11).
Observations of the turbidity regime and solid discharge in the rivers under consideration were performed simultaneously with measurements of water discharges. In total, 116 samples for turbidity were collected. According to these data, 12 discharges of suspended sediments were calculated for the Upper Taymyra and 14 for Logata river.
At the Upper Taymyra, the main flux of solid substances passes during the period of the maximum levels. The discharges of suspended sediments have values about 600-700 kg/s (Fig. 7-14).
At the Logata river, the main turbidity flow occurs during the period of the rise of water levels. The sediment discharges were 1.5 times greater than at Taymyra reaching more than 850 kg/s, although water discharges here are smaller than in Taymyra by 2.5-3 times (Fig. 7-14).
With the passage of the largest water discharges, the discharges of suspended sediments, as compared to the period of the rise of the levels, decreased more than 4-fold. The curves R(H) and Q(R) repeat the curve Q(H) in the character and the form (see Figs. 7-15 and 7-16). For the Upper Taymyra, such dependences also repeat the type of the Q(H) curve, but here the largest solid discharges are shifted to the left (Figs. 7-17 and 7-18). Stability of the relations Q(R) indicates that discharges of suspended sediments are to a great extent governed by the transporting capability of the flow, rather than by the amount of the terrigenous material incoming to the river.

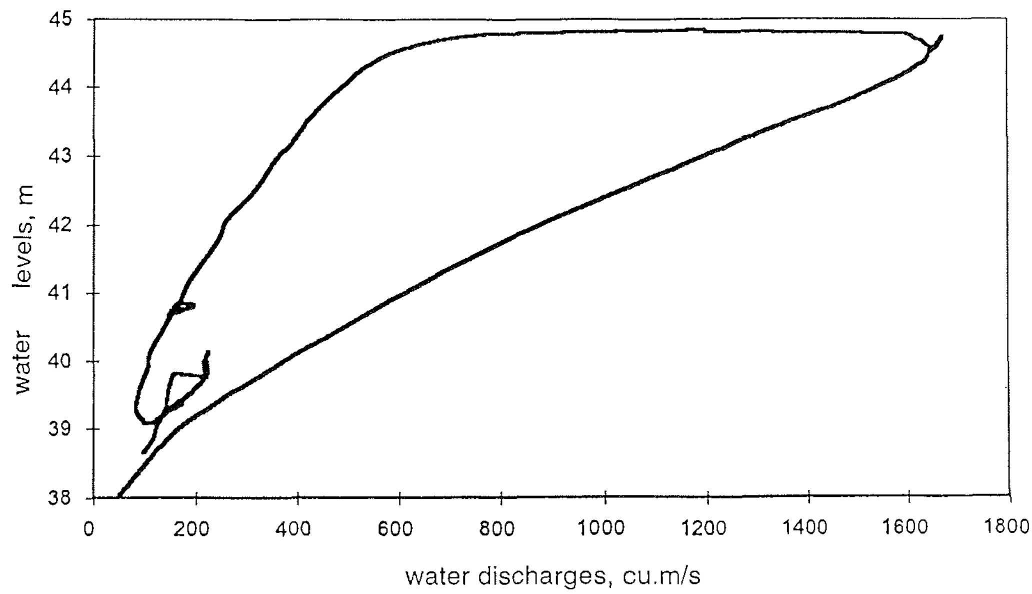


Fig. 7-13: The Q(H) dependence for Logata river

The total outflow of suspended material in the Logata river for the observation period was more than 732 000 t, and the discharge of suspended sediment in Taymyra more than 800 000 t (Fig. 7-19), i.e. practically equal to that of Logata.

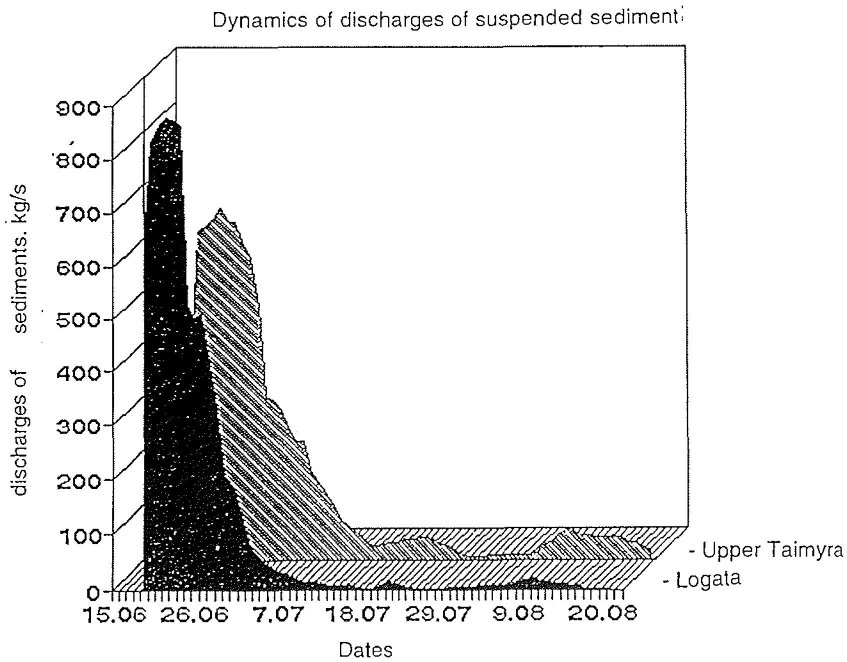


Fig. 7-14: Dynamics of discharges of suspended sediments

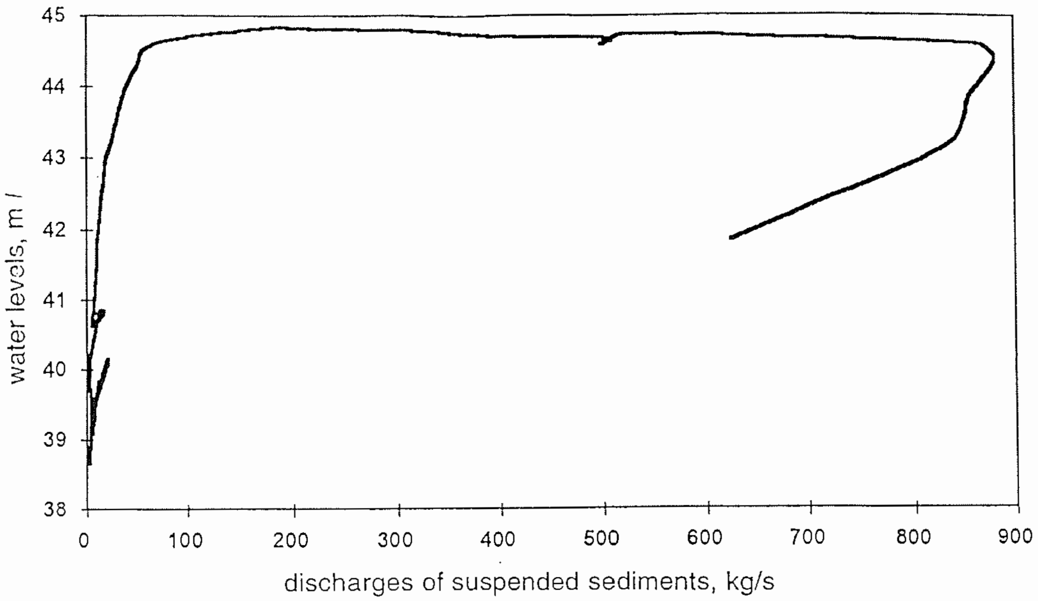


Fig. 7-15: The R(H) dependence for Logata river

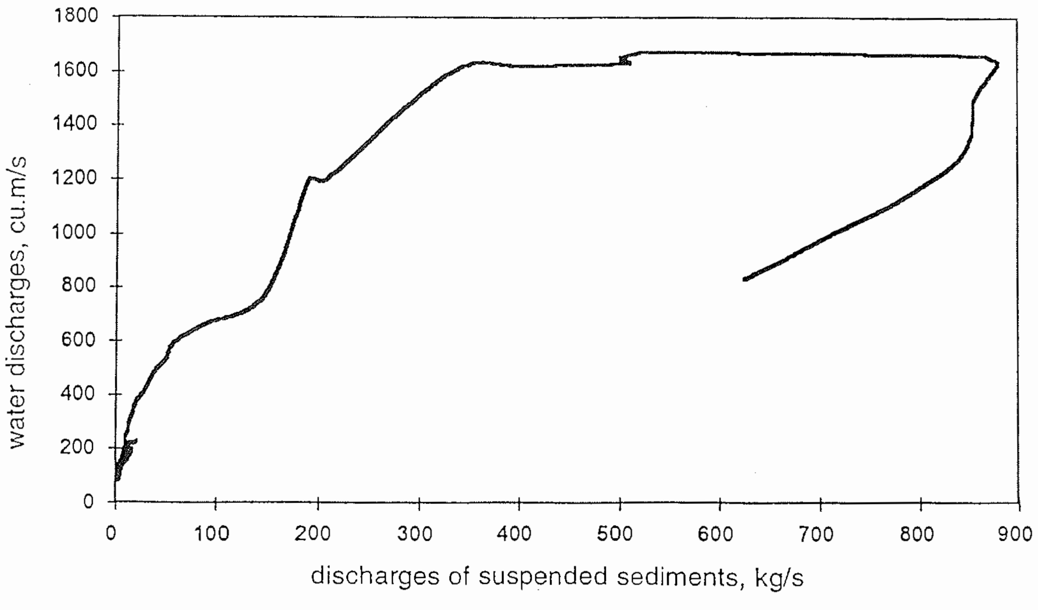


Fig. 7-16: The Q(R) dependence for Logata river

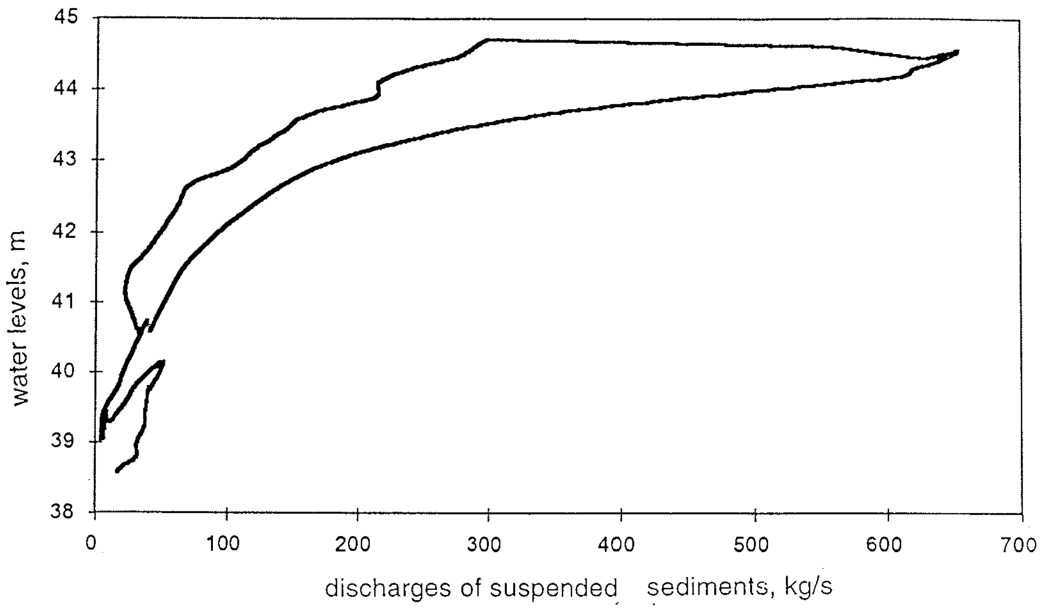


Fig. 7-17: The R(H) dependence for Upper Taymyra river

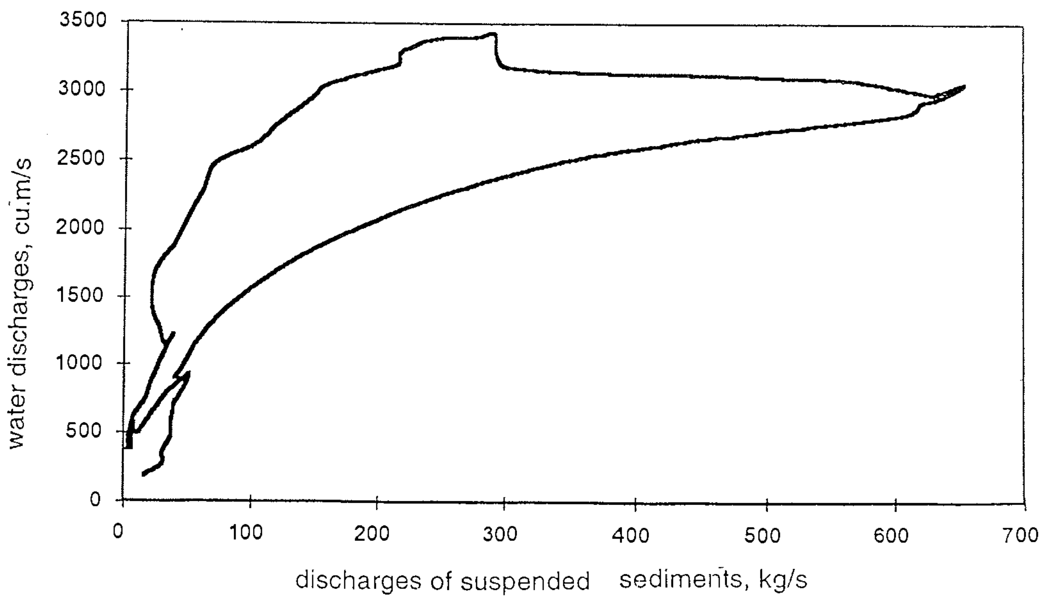


Fig. 7-18: The Q(R) dependence for Upper Taymyra river

The character and the dynamics of the solid and liquid discharges in the rivers govern the character and dynamics of channel deformations. The channel process on the studied segment, as well as over the entire length of the Upper Taymyra river, is governed as a varved-ridge form of transport of entrained sediments. According to measurements at speed verticals, the ridge height in the section of the water gauge has a mean value of about 0.7-0.8 m.

The Logata river along its whole length belongs to the type of free meandering. According to measurements at the verticals in the section of the water gauge, here also the ridge forms of the bottom relief are present. Unfortunately, it was not possible to measure the motion rates of bottom ridges, hence the question about the value of the discharge of entrained sediments is still unsolved.

The erosion of the shores of the Logata river in the observation zone is about 1.2 m a year; at the Upper Taymyra - a little less.

Prior to 1991, the island near the fall of Logata to Taymyra (Fig. 7-6) was connected with the main massif of the interfluve by a dam about 100 m wide. With the flood it was washed out. At the present time the washout is more than 300 m long with low water depths up to 3-4 m.

The erosion of the shores is most active during the ice drift and high level periods, as well as at the end of summer when as a result of the largest soil heating, the solifluction processes on the shores become more intense. In this period an increased content of suspended matter in the river flow is observed and on the precipitous shores large detrital turf covered earthen blocks (up to 2-3 m in diameter) sag and fall down.

Downstream from the fall of Logata, the Taymyra river has practically no large tributaries which are capable to significantly change the runoff of this river. Hence, the obtained data can be estimated as the main constituent in water balance characteristics of its water catchment basin.

If the total runoff based on the observation sections, is compared to the runoff of the flood period of the regulated Lower Taymyra using the downstream measuring section in the area of Zeleny Yary excluding the runoff volume of the Shrenk and Trautfetter rivers, then it is easy to estimate the fraction of the inflowing constituent of the Upper Taymyra regarding the water balance of the basin of the Taymyr Lake and the Lower Taymyra river.

Thus, the total runoff of the Lower Taymyra with the runoff of the Shrenk and Trautfetter rivers is about 33 km^3 a year, being about 23 km^3 for June-August. The rivers Shrenk and Trautfetter comprise about 25% and 7%, respectively, of the runoff of Lower Taymyra. The total runoff of the Upper Taymyra based on 1995 data is about 12 km^3 for June-August, i.e. more than 75% of the flood runoff of the Lower Taymyra river and more than 55% of its annual runoff. The solid discharge of Lower Taymyra at the Zeleny Yary section is about 500 000 t a year. Thus it is evident that the main mass of sediments transported to the Taymyr Lake with the inflow component, precipitates there.

Conclusions

Evidence presented in this report allows a conclusion that the obtained data are undoubtedly of scientific value, first of all, regarding their priority significance at the scales of regional studies. As to estimating the dynamics and processes occurring at the water flows of the central Taymyr basin, the obtained material is only comparable to data on the downstream measuring section of the Lower Taymyra, as well as the Krasnaya river.

Likewise, the comparison of the runoff characteristics of the Upper Taymyra runoff in the water balance regime of the Taymyr Lake based on the presented data, is still the first quantitative approximation reflecting general ratios of the runoff parameters of the channel network of this basin. For more accurate calculations it is necessary to conduct simultaneous observations at the main sections of the water flows falling into the lake (Upper Taymyra, Bikada and Yamutarida) and at the downstream section of the Lower Taymyra river (separately with the Shrenk and Trautfetter rivers).

This conclusion can also be considered a recommendation for planning full-scale hydrological studies of the central Taymyr in the future. Studies of the processes of the dynamics of dissolved substances and hydrochemical processes in the Lower Taymyra basin should be extended in a similar way.

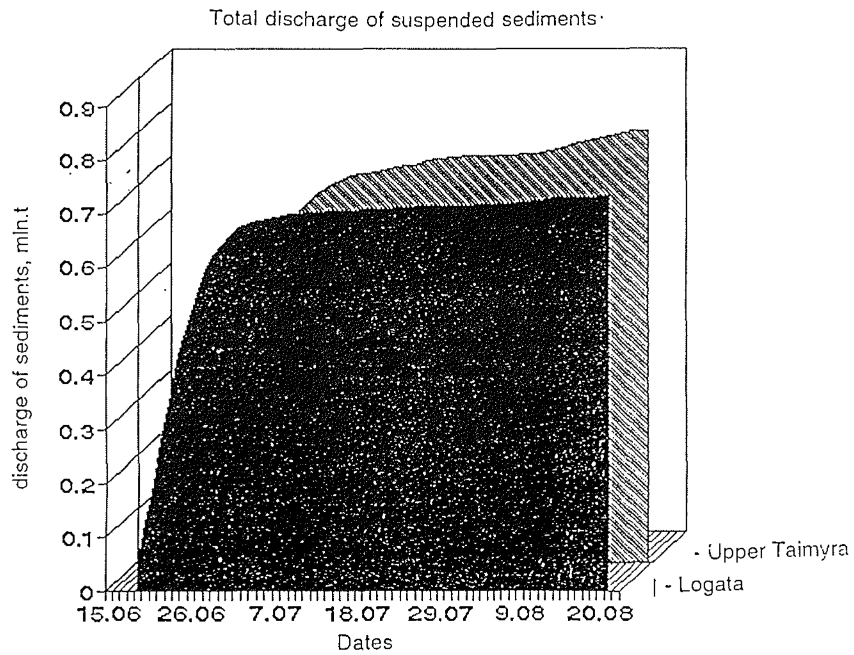


Fig. 7-19: Total discharge of suspended sediments

7.5 Soil nutrient distribution in active layer during freezeback, Taymyr, Siberia (P. P. Overduin)

7.5.1 Introduction

When the active layer begins to freeze in late summer, plants enter an important period of nutrient acquisition (Bliss et al. 1981). Nutrient inputs provided by precipitation and the leaching of substrate material by water gain significance as colder temperatures limit fixation. The freezing of the active layer in late summer and the exclusion of solutes from the descending freezing front may have a role in determining the availability of nutrients for plants, and their consequent competitiveness at the start of the following growth season. Few studies consider the availability and location of nutrients in active layer when evaluating the nutrient balance of a system; fewer still have monitored the transfer of nutrients at the season's definitive end: the refreezing of the active layer.

7.5.2 Objective

The purpose of this study is to investigate the distribution and flow of nutrients within the active layer over time and at sites with contrasting parent materials and geomorphologies during the onset of the fall freeze-back period, and to relate this movement to soil moisture and temperature. The effect of refreezing on nutrient distribution and availability to vegetation and this information is also important for an understanding of the seasonal cycling of resources within a plant community.

7.5.3 Methods

Three sites were selected for intensive study: one in the fluvial plain and one each at the base of a calcareous slope and a sandstone slope. Site selection criteria included: a range of sites within the lake basin, but with one restriction on the type of substrate The drilling equipment worked effectively only for fine grained substrates (at potential sites upslope gravel horizons within the active layer prevented coring). Cores of the active layer were obtained at each site on at least two sampling times. At some sites and times, up to five cores of up to 900 mm length were taken; two cores minimum were taken at all sites, at all coring times. Two cores at each site were sliced and oven dried for gravimetric moisture determination and comparison with vertical time domain reflectometry (TDR) profiles of volumetric water content made at the time of coring. The dried samples were retained for particle size analysis. All remaining cores, including some taken upslope of the sandstone slope site, were frozen upon retrieval, sliced into 20, 30 or 40 mm segments, bagged and kept at freezing temperatures. Additional cores were taken at each site, beginning at the thawed/frozen ground boundary, into the frozen ground. These cores ranged in length from 20 to 50 cm and were retrieved as 2 or 3 cm segments. These segments were bagged and remained frozen. At the fluvial plain site, additional frozen ground cores were recovered and sliced. After thawing of the segments, the soil water was decanted for isotope analysis. All core material remained frozen throughout transport to Potsdam, where it was stored at -22°C. Soil waters were sampled at the three selected sites using soil suction lysimeters. Usually, samples at one depth only per profile were recovered, depending on moisture levels at the specific horizons. Generally, the frozen upper layer limited sampling to the deeper lysimeters.

7.5.4 Analyses

Analyses of the cores samples will include physical parameters: ice content, water content, organic content, grain size analysis, density and porosity. Soil waters will be extracted and the soils will undergo extraction. The resulting solutions will be analyzed along with the water samples for pH, conductivity, major cations and anions, as well as ammonium, nitrate, nitrite and soluble phosphorus (Annex 11.1-7). Good correlations between the gravimetric and TDR volumetric water content determinations allow confidence in the TDR data over the course of the fall. It is expected that the advance of the freezing front downward through the active layer will be visible in both the moisture data and in the chemical data. Conclusions concerning the depth profiles of the various elements will be drawn, and related to differences between sites and their thermal and moisture regimes. The development of the upper frozen layer will also be discussed in terms of its effect on the chemical profiles.

8. LACUSTRINE GEOLOGICAL STUDIES

8.1 Lake sediment sampling on Taymyr peninsula
(P.P. Overduin, D. Bolshiyanov and T. Ebel)

8.1.1 Objectives

The first phase of the 1995 Taymyr Project sought to realize goals formulated through a pilot study conducted in 1993 (described in Melles 1994). The exploratory expedition took place in the regions surrounding Norilsk and on the Taymyr Peninsula. On the Taymyr Peninsula, the expedition visited Levinson-Lessing Lake, travelled to Taymyr along the Ledyannaya river and later travelled along the Khatanga river. Short sediment cores were successfully recovered from Levinson-Lessing Lake and from the Khatanga river. On the basis of these cores, as well as ice and soil samples, the first phase of the 1995 Taymyr Project was planned to investigate the palaeoclimatic history of the area through the study of lacustrine sediment records.

It was hoped that full paleoclimatic records could be won from the area, and thus, that the late Quaternary environmental history of Central Siberia, including the extent and frequency of glaciation, could be elucidated. Initially, seven lakes were selected as targets for coring: Levinson-Lessing, Kokora, Taymyr, Portnyagino, Syrataturku, Kungasalakh and Labaz Lakes, in that order of priority. (see Fig. 8-1). They cover an area that is supposed to have been only partially glaciated during the last maximum and that today ranges from subarctic to Arctic tundra. Investigations of the present-day sediment formation, and comparisons with results from the palaeoenvironmental data archives, therefore, promise reconstructions also of vegetation zone migrations during the late Quaternary climatic variations.

This report describes the expedition, the lakes sampled and the sample material retrieved during the first phase of the 1995 Taymyr Project.

8.1.2 Itinerary

The expedition was the first of four expedition steps carried out in the Taymyr region in the summer of 1995 as a co-operative project between the Alfred Wegener Institute, Potsdam and the Arctic and Antarctic Research Institute, St. Petersburg. The first expedition was to be mobile, and sample lacustrine sediments in the early spring while the stable lake ice afforded a stationary platform. Problems with anchoring a floating platform over a sampling site during the 1993 expedition led to this decision. The following phase of the project was to set up a stationary camp on the north shore of Levinson-Lessing Lake.

On April 30, most of the sediment project's equipment was flown to a small water basin just north of Labaz Lake. Two Russian group members remained in Khatanga to organise later flights, food supply and radio contact through the Hydrological Base.

Small Kokora Lake
Two helicopter (Mi 8) flights were required to transport the necessary tents, fuels and coring equipment to Lake Kokora. Coring on Small Kokora, began on the 2nd of May and continued until and including the 5th. On May 6 the camp was dismantled and the following day carried to Portnyagino Lake using one aeroplane (AN2) and one helicopter (Mi 8) flight. En route, both aircraft stopped in Khatanga, where the sediment material was unloaded for storage in an AARI-owned house.

Portnyagino and Taymyr Lakes
The base camp on Portnyagino was located in a fisher's hut on the island. After 6 days work (on May 14th), two AN2 aircraft, making four flights, transported the entire camp, plus the remaining equipment (mostly food) left behind in Khatanga, to Lake Taymyr's deepest point. Victor Meshcheryakov and Alexander Petukhov flew to Khatanga at this point, in order to carry out a snow sampling survey of 12 points between Khatanga and the northernmost coast of the Taymyr Peninsula. During the six days on Taymyr, it was necessary for the leader of the Russian expedition, D. Bolshiyanov, to fly to Khatanga for the organisation of both return flights to St. Petersburg and the flights of the second expedition from the same city to Khatanga. The aim was to allow the two expedition groups an overlap of at least one week at Levinson Lessing Lake, during which time a co-operative effort would ensure that the transfer of materials and equipment was successful. The flights were organised over Norilsk as regular flights to Khatanga had ceased.

Levinson Lessing Lake
The group was transferred by three AN2 flights, this time to Levinson Lessing Lake. Camped again at the deepest part of the lake, the group spent 13 days coring, sampling snow and measuring subsurface ground temperatures at the north end of the lake. On the 22nd of May, an automatic weather station was set up at the north-east end of the lake and began collecting data.
On June 4, the second expedition arrived by helicopter and a camp was set up on the north shore of the lake, just west of the Krasnaya river. All equipment was transferred from the coring site to the camp using two skidoos. After four days of joint work together with the second expedition team, five of the first expedition members returned to Khatanga. On June 9 an AN-26 flight brought them to Norilsk, and a further regular flight to St. Petersburg.

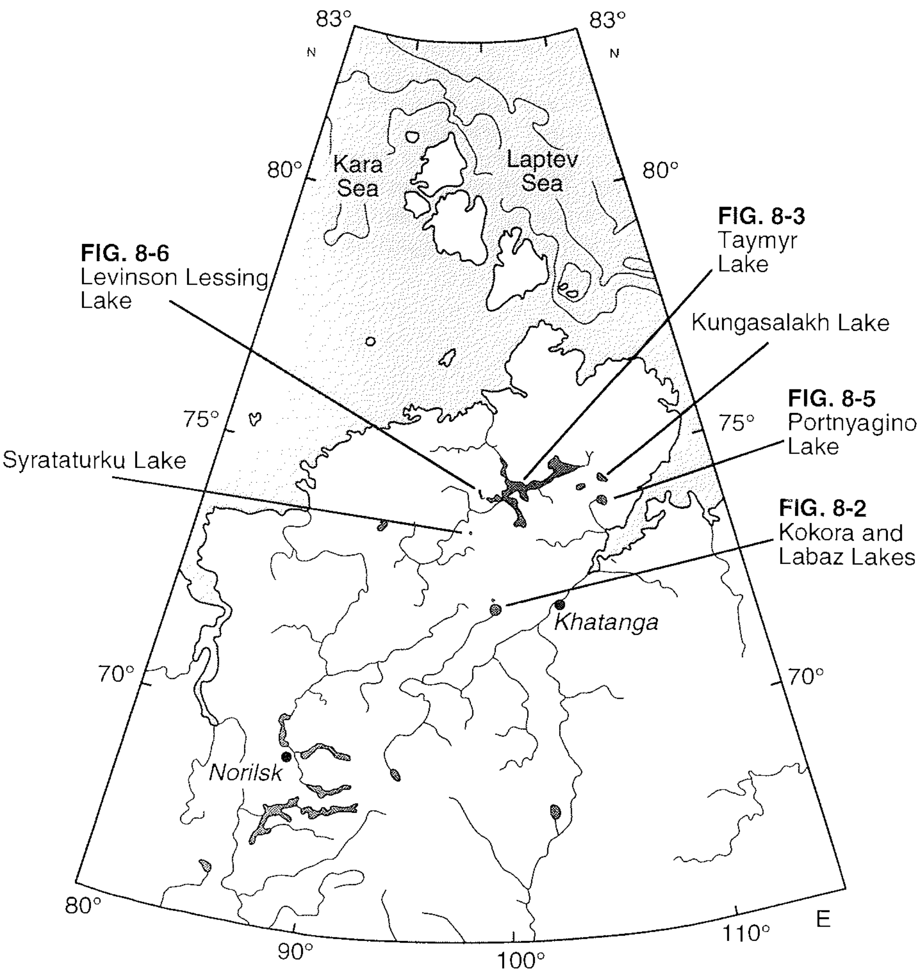


Fig. 8-1: Northern Central Siberia

8.1.3 Climate and Geography

The Taymyr Peninsula is the world's most northerly continental land mass and has a continental climate. Temperatures range from under -60 °C to ca. 30 °C in the southern region (Labaz Lake data). Levinson-Lessing has a colder, windier climate than the other lakes, with a correspondingly shorter frost free period (Levinson-Lessing has 50 frost free days per year, while Labaz has 73). Precipitation for the area is between 200 and 300 mm per year. The permafrost depth at Labaz Lake is 400 m and lies between 500-700 m at Levinson-Lessing (Adamenko & Egorov 1985, Vasilyevskaya 1980, Ershov 1989).
The first three lakes sampled lie in the Taymyr Lowland. Labaz and Portnyagino lie south of the Byrranga Mountain range, Taymyr lies northward of the southernmost ridge while Levinson-Lessing lies in the Byrranga range itself, at an altitude of 47 m above sea level. The Levinson-Lessing Lake basin was carved by glacial action, whereas the current forms of Taymyr, Portnyagino and Labaz are the result of a combination of glacial/periglacial and thermokarst processes. The distribution of the sampling sites within the transition from a subarctic region to a high-Arctic polar desert region will allow the reconstruction of vegetation zone migrations within the late Quaternary climatic variations.

8.1.4 Methods of Sampling

Sampling technique
The positioning of geological sampling locations was by satellite navigation (GPS, Global Positioning System) with a general accuracy of ± 150 m. The water depth at the sampling site was determined during sediment coring by a rope-length meter.
A special tent which allowed working under very cold and windy conditions (constructed and manufactured in St. Petersburg) was set up on every of the four lakes.
Sampling of lacustrine sediment sequences was carried out by using two different coring systems from a 4.5 m high tripod assembled on and supported by the lake ice. This equipment was entirely produced by UWITEC (Austria) and represents standard gear, in some cases modified for the specific requirements of high-latitude areas.
A light gravity corer (SL, "Schwerelot") was employed for the sampling of undisturbed near-surface sediments from deep waters.
In low water depths of up to ca. 10 m, undisturbed near-surface sediments were recovered with a hand-push corer (HS, "Handstechrohr"). For that, the gravity corer (SL) was provided with variable aluminium tubes at its head and pushed into the sediment by hand. The core catcher was released by slackening of a core rope, which was guided and held taut inside the aluminium tube.
Long sediment cores were recovered with a piston corer (KOL, "Kolbenlot"). The KOL can be used with 2 m and 3 m long steel tubes, covering exchangeable inner PVC liners of similar lengths and diameters of 3 or 5.9 cm, respectively. The KOL is operated by 3 hand winches mounted on each of the tripod legs.
The momentum for penetrating the sediment is delivered by a cylindrical weight that serves as a hammer on the top end of the coring device.

To prevent sediment loss at the tube base the KOL can in addition be supplied with different core catchers.
The maximum recovery with every employment of the KOL is limited by the tube length to 3 m. Deeper sediment horizons can also be sampled, however, because the start of the coring process during penetration of the gear can be controlled by the release of the piston, which is fixed in the tube mouth on its way through both the water column and the overlaying sediments. Hence, by coring of several overlapping horizons and subsequent correlation of the cores, a continuous sediment sequence of much higher length than 3 m can be obtained.
For detailed descriptions concerning the coring technique see Melles et al. (1994).

Sample storage and transport

Sediments with relatively low water contents could be stored and transported directly in the liner tubes. For that purpose the up to 3 m long PVC tubes were cut into pieces of up to one metre length and closed at both ends, largely air- and waterproof, by suitable plastic caps and flexible tape.
Sediment present in or below the core catcher was recovered, segmented in 1 or 2 cm thick slices, and stored in plastic flasks of 50 ml volume or in plastic bags. The plastic flasks were of known weight and air- and waterproof, enabling determinations of sediment water content and related physical properties. The same style of storage was necessary for sediments with very high water contents because movement and vibration during transport could result in separation of pore water and sediment particles and thus in destruction of sediment stratification and structure. In practice, this was necessary for near-surface sediments and especially in algal mats and moss layers. The sequences were cut into 1 or 2 cm slices by the use of special cutting equipment.
All sediment samples were stored at slightly positive temperatures. In the field heated, insulated aluminium boxes served to keep the cores from freezing. Unfortunately, the wind-blown snow proved to be too great a challenge for the generator, and the cores were often kept warm using hot water bottles and packages of coffee heated on the diesel oven. Sediment material was transported to Khatanga as soon as possible and stored there at temperatures of approximately 20°C. Further transport to St. Petersburg occurred on July 16, 1995 where the samples were stored at the Arctic and Antarctic Research Institute (AARI) until they were finally shipped to Potsdam in the end of October.

Micro-organism Sampling

In addition to the sediment coring all four lakes were sampled for micro-organisms. This was done using a 25µm net which was pulled up through the water column from a certain depth. Living micro-organisms were preserved in alcohol and stored for transport in small plastic flasks.

8.1.5 Sediments

Investigations of lake sediments on the Taymyr Peninsula are relatively rare. In 1985, the sediments of the central Siberian lake, the Taymyr Lake, were sampled and yielded ten cores, all of less than one meter length (Adamenko, V.N. & Egorov, A.N., 1985). The pilot study for the current project collected lake sediments from Khatanga and Bikada rivers and Levinson-Lessing Lake in 1993 (Melles et al., 1994). Other work has concentrated on records stored in the permafrost, such as exposed lacustrine and marine deposits and ice complexes (e.g. Kind & Leonov 1982, Bolshiyanov 1994). Lake sediments usually provide more complete depositional sequences than other terrestrial sediments. Commonly occurring high organic carbon contents in lake sediments often enable detailed age determinations via radiocarbon dating. The possibility of obtaining stratigraphic information, together with a high sedimentation rate allowing high resolution reconstruction, differentiates lake sediments from exposed terrestrial sequences and continental shelf sediments.

This part of the Taymyr '95 expedition, the goal of which was to collect lacustrine sediments from the Taymyr Peninsula, is thus seen as a complement to the projects currently running in the Laptev and Barents Seas. Also complementary are the geocryological investigations at Labaz Lake, being carried out as a part of the Taymyr '95 expedition. Studies of current phenomena, such as lake water balances and hydrological regimes, riverbed sediment transport, lacustrine sedimentation rates and active layer hydrology are being investigated in the Taymyr region and will complete our understanding of present-day sedimentation processes in the region.
The selected lakes give a good coverage of the Taymyr Peninsula, and therefore allow formulation of a complete set of constraints on the area's palaeoenvironmental history. Of the six planned sediment sampling sites, only four were practical within the time constraints of the expedition. An earlier start to the expedition would have allowed further sampling; the expedition ended, however, two days before the ice surface on Levinson-Lessing Lake began to melt. At each lake our first goal was to obtain a complete sediment sequence at a site close to the lake's deepest point. A complete sequence was probably reached at all sites but for Levinson-Lessing Lake. All sediment material recovered during the expedition is listed in Table 11.1-8. There follows a short comparative description of the lakes, which is in turn followed by descriptions of the sequences themselves.

Small Kokora Lake
Kokora Lake lies in the Kheta Basin, to the north-west of Labaz Lake (see sketchmap Fig. 8-2). The lakes in this area are mostly formed through thermokarst processes, and the larger lakes are often the product of unification of numerous smaller thermokarst waterbodies. Kokora has only one outflow, flowing into the Large Kokora, which in turns flows into Labaz Lake. Small Kokora was also selected based on its depth (at 22 m it is probably one of the deeper lakes of the Labaz region) and definable watershed.
The Kokora Lake's sediments consist mainly of grey clayey-silty mud. In the upper 15 cm, organic litter (moss fibres) can be identified. Down to a sharp boundary at a depth of about 4 m, no major changes in sediment characteristics nor small-scale laminations were to be distinguished. Below that boundary, the sediment becomes much dryer and changes to fine- and medium-grained quartz sands containing some small and slightly rounded pebbles (∅ 6-10 mm). Probably due to higher terrestrial organic matter contents the sediment colour alters into a darker, brownish grey.

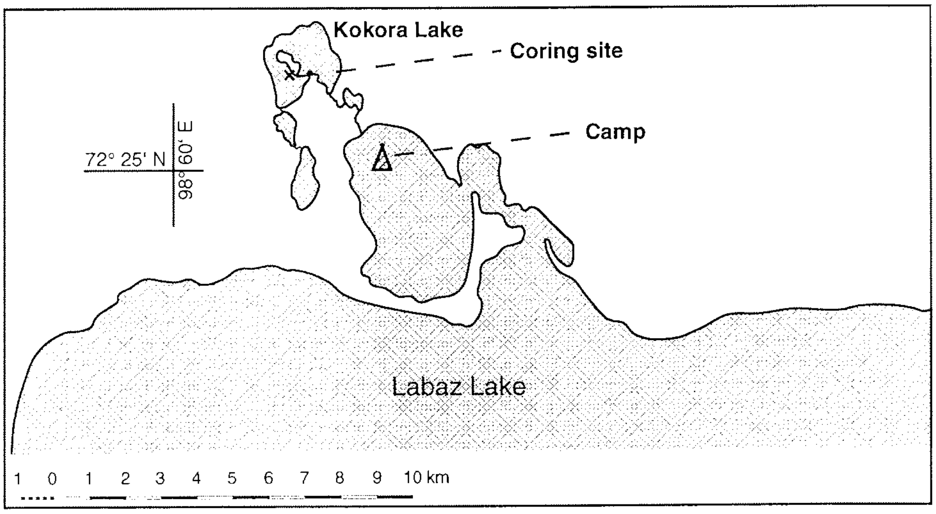


Fig. 8-2: Kokora and Labaz Lakes

Taymyr Lake

Lake Taymyr is the largest water body of the Taymyr peninsula (Fig. 8-3). Like the Portnyagino it presents a fluvial plain flooded as a result of tectonic movements. Approximately 70% of the lake's area has a depth of less than 3 m, much of which is frozen completely in winter. At its deepest point, Lake Taymyr has a depth of almost 26 m (Fig. 8-4). As with other shallow lakes in the Taymyr a sub-aquatic permafrost often forms in the shallower areas of the lake, precluding the presence of a talik.

The sediment sequence, which was recovered near the deepest part of the lake between the polar station "Taymyr Lake" and the Yuka-Yamu bay, reaches down more than 14 metres beneath the lake's bottom, consists mainly of clay and silt and is, except in the uppermost part, of uniform grey colour. In the deepest part, the consistency changes to an unsorted mixture of sand, silt and clay - most probably alluvial deposits - that was impossible to penetrate by means of light coring equipment. Due to a relatively high content in dissolved gas - probably methane - many gas bubbles formed when pressure was released by pulling the cores up through the water. This resulted in an expansion of the sediment material of approximately 1-5%. Traces of bioturbation were found close to the water / sediment interface.

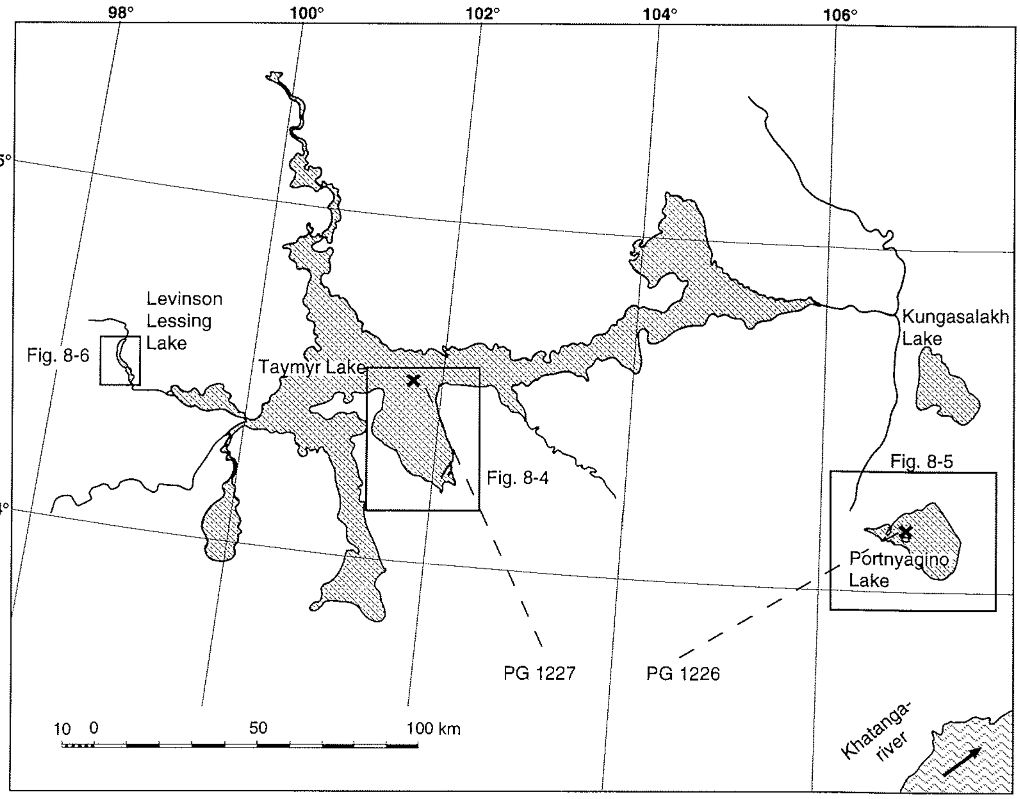


Fig. 8-3: Taymyr Lake

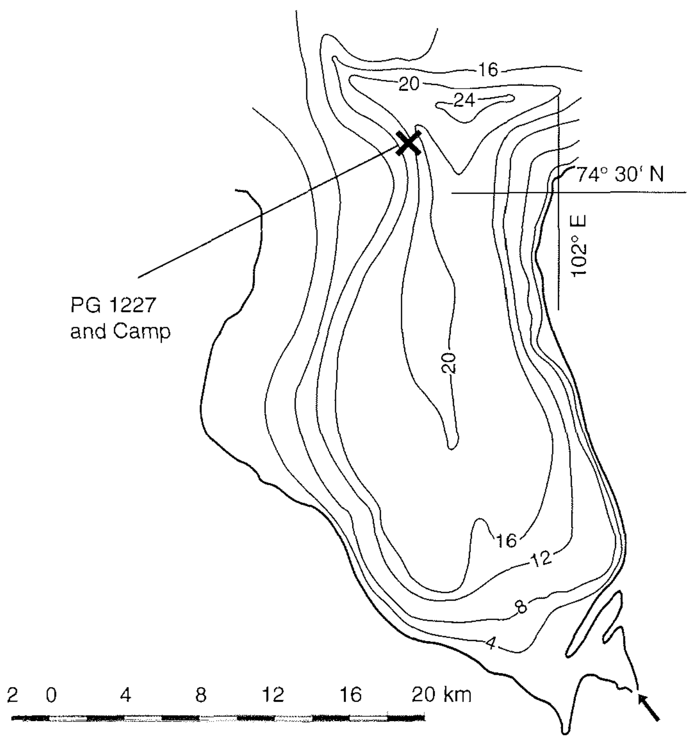


Fig. 8-4: Southern Taymyr Lake

Portnyagino Lake

Portnyagino Lake lies beyond the commonly accepted boundary of Karginsk Glaciation. It presents a fluvial, water-filled and structurally dominated plain of the Biska-Gusikha rivers and was hoped to provide a periglacial sediment record for comparison to those won at Taymyr and Levinson-Lessing Lakes. The lakes' depth was unknown and two depth profiles, with measurements every 2.5 km, revealed that the lake, although large probably does not reach a depth greater than 4.5 m. All depths measured lay between 3.7 and 4.2 m (Fig. 8-5). The lake's present form suggests a fluvial origin, with the gradual filling in of a fluvial plain to the present lake depth. An uninterrupted sediment sequence could therefore not be expected.

In the sediment column no distinct laminations were recognised. Beyond a thin sandy layer in a depth of 2-3 cm, the sediment is densely packed, consisting mainly of clayey silt/silt and is of a uniform grey colour down unto the sandy base. Irregularly spread patches of rusty brown organic litter form the uppermost part of the sediment sequence.

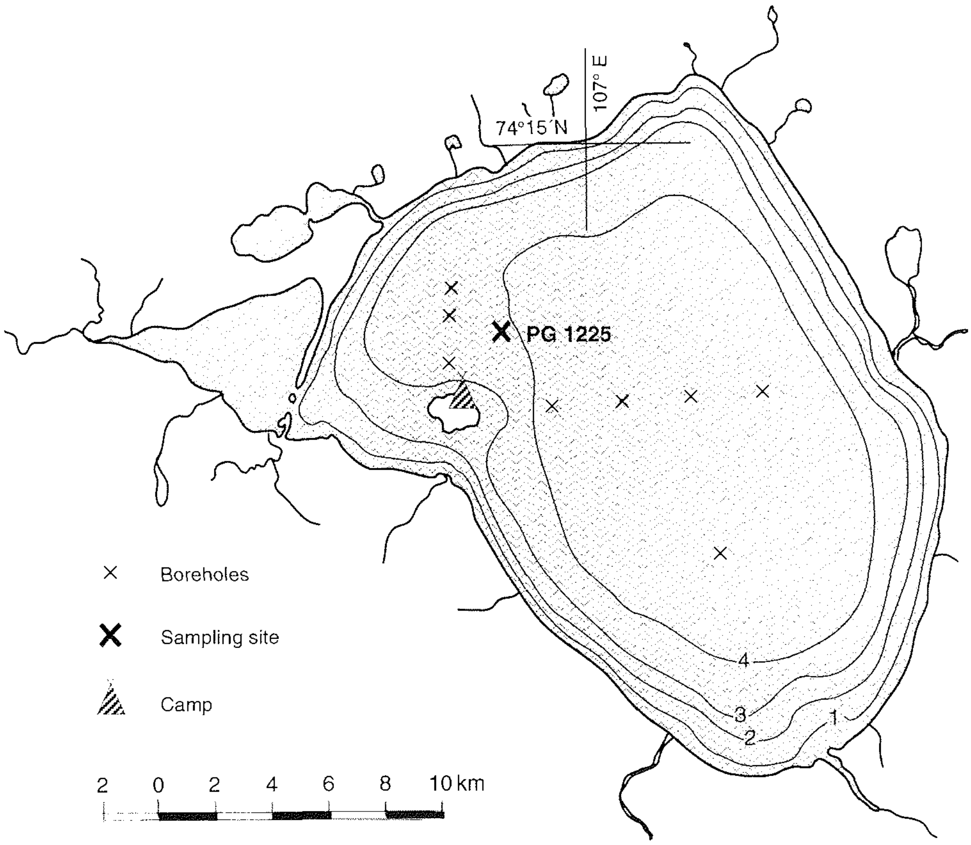


Fig. 8-5: Portnyagino Lake

Levinson-Lessing Lake
Levinson-Lessing, at 47 m above sea-level the expedition's 'high-altitude' lake, lies in the southern Byrranga Mountains and flows through the Ledyannaya river into the Taymyr Lake. The lake is roughly 15 km long and 108 m deep at its deepest point (see Fig. 8-6). Numerous rivers flowing into the lake complicate the terrigenic sediment composition of the lake. The large Krasnaya river feeds into the lake's northern end building up an alluvial fan.

Levinson-Lessing Lake yielded the longest sediment sequence so far which reaches down more than 22 metres into the sediment body. As in Taymyr Lake the sediments contain a considerable amount of dissolved methane which expanded probably during recovery under the lower surface pressure conditions.
The sediment is of a slightly greenish grey and of a high water content down unto approx. 12m where it becomes dryer and sandy. At a depth of 12.40 m a layer of some cm of organic remains (probably mosses) was found. Below that layer water and gas contents increase again.

In total, more than 60 m of sediment were recovered. After the field campaign these sediments will undergo several investigations concerning their physical and chemical as well as textural composition. Pollen analysis combined with some other "absolute" dating methods (like radicarbon dating) will allow the chronological reconstruction of the region's paleoenvironmental situation for a time span of up to >30 ka.

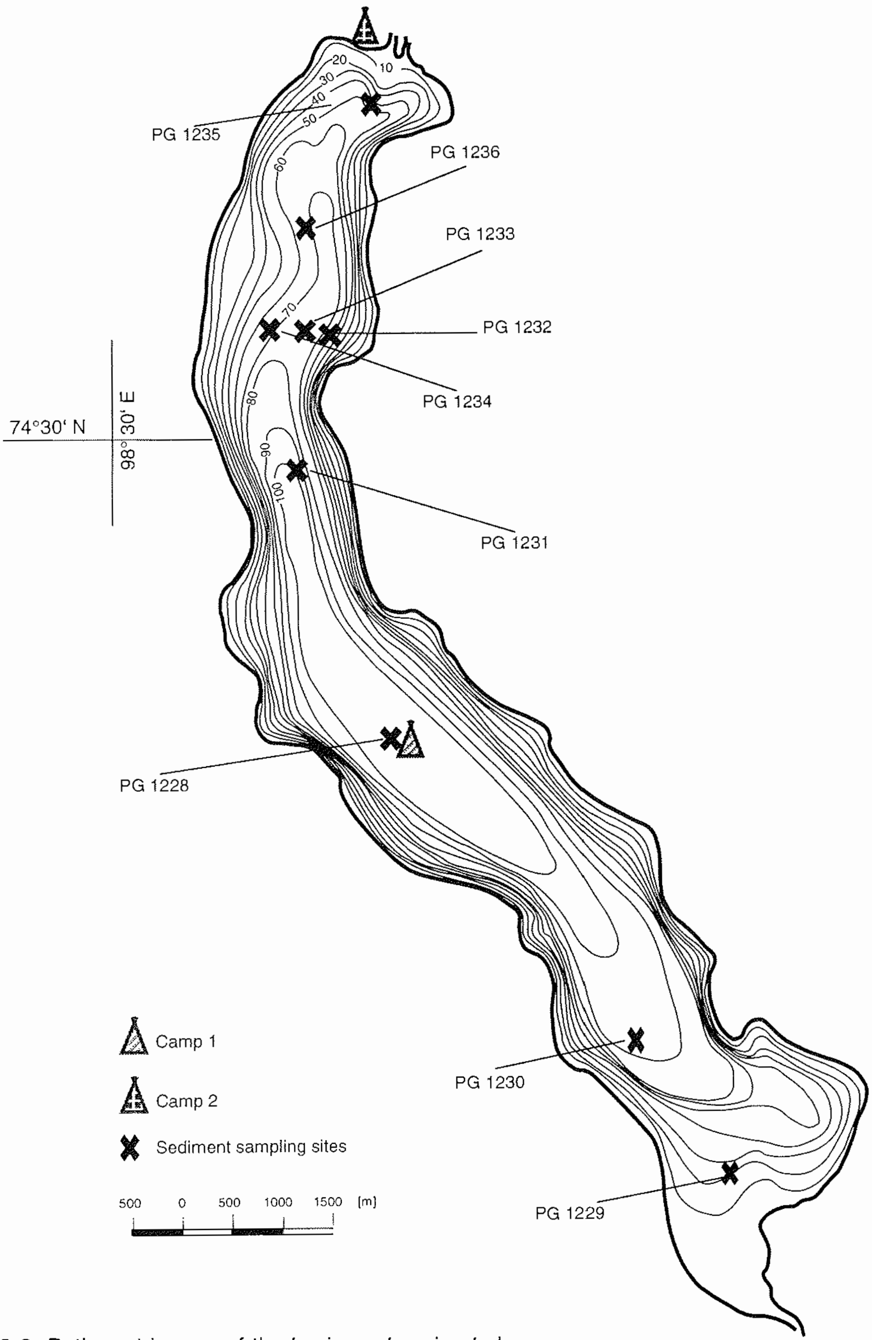


Fig. 8-6: Bathymetric map of the Levinson-Lessing Lake

8.2 Pilot study of lakes on the Severnaya Zemlya Archipelago (H.-W. Hubberten and D. Yu. Bolshiyanov)

In order to plan the lake sediment sampling in lakes on Severnaya Zemlya during the Taymyr/Severnaya Zemlya expedition 1996, a short reconnaissance study was carried out between August 8 and 13, 1995. According to information available from earlier AARI expeditions, all lakes which are possibly favourable for drilling were visited (Fig. 8-7). Photographs were taken from the helicopter in order to document size, water inflow and ice coverage of the lakes. Preliminary studies were carried out after landing at each lake. The lakes visited during the expedition were:

1. Geographers Lake on Komsomolets Island (east end at 80°10'49"N; 94°07'05"E)

This lake is located at the south western side of Komsomolets Island and dammed at its north-eastern side by the Academy of Science glacier. It is about 5 km long and 3 km wide and has a depth of ca. 30 m. During our visit on August 10, the lake was still partly covered by ice, inspite of the relatively warm temperatures which were documented by creeks coming out from the glacier or running over the icefree surfaces, carrying red coloured suspencion freight into the lake. Due to the fact, that the lake is bounded at its northern side by the glacier it is highly probable that it was transgressed by the glacier during the little ice age and may therefore contain sediments some few hundred years only.

At the western side, the Geographers Lake is connected by a small channel with Angels Lake which is some 12 km long and 2.5 km wide and has more or less the same appearance as the former, i.e. similar ice coverage and direct contact to the Academy of Science glacier.

2. Changeable Lake on October Revolution Island (East end at 79°06'10"N; 95°12'04"E)

The Changeable Lake is located at the south-western side of October Revolution island and some 7 km away from the southern edge of the Vavilov glacier. The lake has a diameter of about 6 km and is structured in its subbottom topography into three basins with 16, 13 and 12 m depth resp., which are separated by sublake ridges. In an earlier expedition a 16 m long sediment core was drilled from this lake by the AARI which is throughout warved and argues for an age coverage of more than 10,000 years. Due to the continuous strong rainfall a large amount of water with red coloured suspension load was carried into the almost ice free lake on August 10 and 11, 1995.

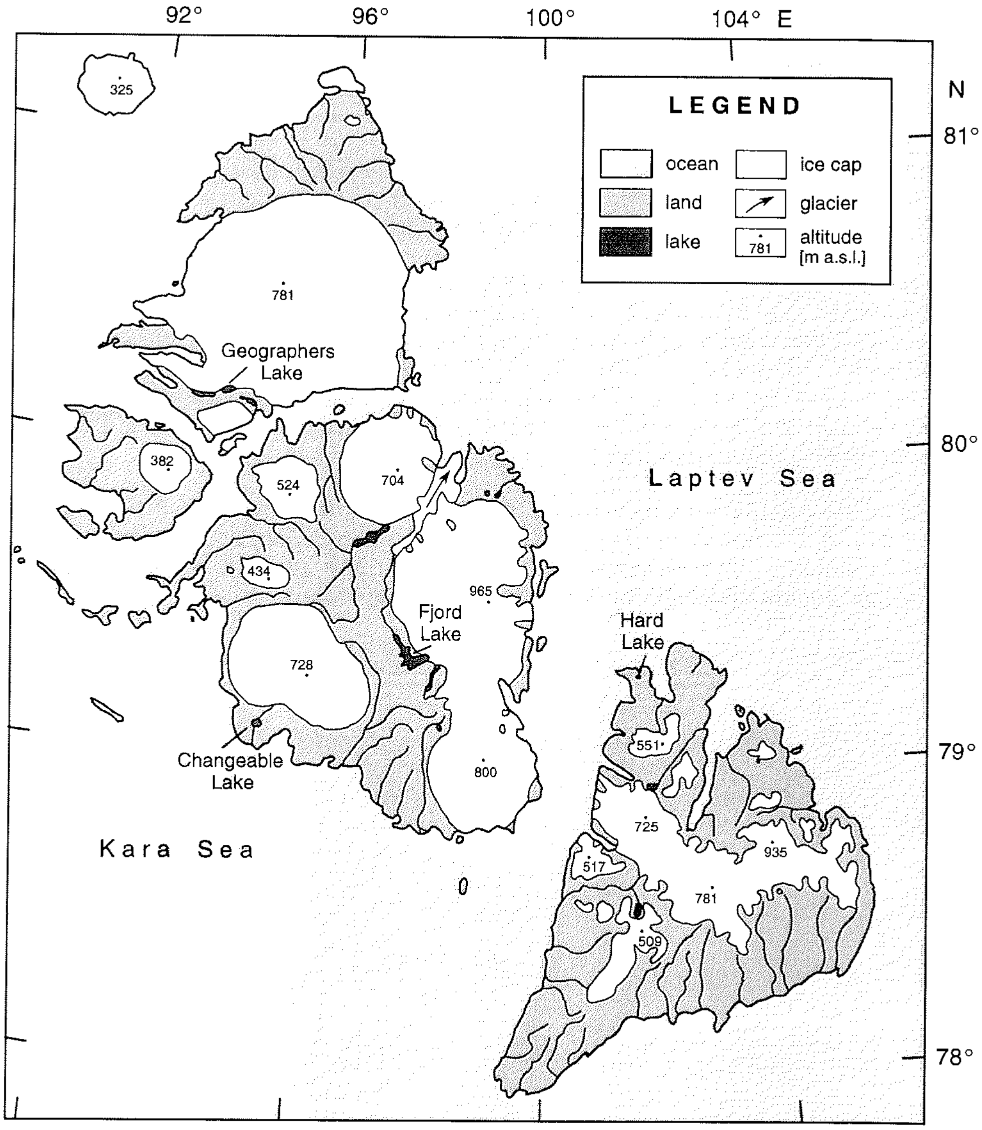


Fig. 8-7: Map of Severnaya Zemlya showing the lakes visited during the expedition

3. Fjord Lake on October Revolution Island (north-eastern end at 79°22'45"N; 97°44'22"E)
With an extension of 35 km the Fjord Lake is the largest lake on the Severnaya Zemlya Archipelago, which also displays the highest depth of up to 90 m. The lake is dammed at its north-eastern part by the Karpinskyi glacier which completely fills the fjord which would otherwise open the lake to the sea. During the visit in 1995 on August 10 and 11, the lake was almost completely covered by one- or multi-year ice. Only at the borders, close to dark cliffs, some few meters of open water could be observed. During an earlyer expedition of the AARI only sediment cores of 35 cm maximum length could be obtained but it is not known whether they reached the subsediment surface or not.
4. Other lakes on October Revolution Island
A series of lakes exists north of Fjord Lake extending further north and west. All of these lakes are not suitable for sediment coring because they are either drying out during dry seasons or have a direct contact to the open sea through deeply erdoded fjords
5. Hard Lake (79°15'13"N; 101°49'17"E) and other lakes on Bolshevik Island
The Hard Lake is located south of Prima station and serves as freshwater source for the station. With about 2 km diameter the lake is relatively small with a maximum depth of 7 m. Several other small lakes exist on the northern part of this island but all do not look favourable for sediment sampling. One larger lake, shown in the map at the southern part of Bolshevik Island, could not be visited during this expedition.

Due to the impressions obtained during the pilot study carried out in 1995 as well as the information and experiences of the AARI scientists obtained during earlier studies, Changeable Lake and Fjord Lake are the most promising lakes for sediment sampling during the 1996 expedition.

9. ENVIRONMENTAL STUDIES

9.1 Snow cover studies

(D. Bolshiyanov, A. Petukhov and V. Mescheryakov)

The snow-measuring survey carried out during the first stage of the expedition along with sampling of bottom lacustrine sediments had two objectives: determination of moisture supply in the Levinson-Lessing Lake for calculating its full water balance and balance of sediments and the determination of the extent of pollution of the snow cover as a result of atmospheric transfer of pollutants in the atmosphere in winter of 1995. For resolving the first objective, the snow survey in the Levinson-Lessing Lake was conducted at 13 profiles over the basin area (Fig. 9-1). The length of snow-measuring traverses was from 1.7 to 31.4 km. The number of points for measuring the snow cover depth and snow density depended on the length of traverses. In traverses longer than 10 km, the snow cover depth was measured by a snow stake and by pits (at a significant snow cover depth) every 100 m, with snow density measurements by a snow sampler at each tenth point, i.e. every 10 km of the traverse. In traverses shorter than 10 km, the snow cover depth was measured every 50 m and snow density - every 500 m of the traverse. Traverses were made on foot and using a snow mobile "Buran". As the work at the Levinson-Lessing Lake began at the end of May/beginning of June the snow survey reflected the full period of winter snow accumulated in the lake basin from September 1994 to June 1995.

For resolving the second objective, the snow survey was accompanied by snow sampling along a meridional profile from the Khatanga settlement to the Cheluskin Cape. The length of the snow measuring surveys varied over a wide range depending on the transportation way of the snow survey team. At the Labaz and Portnyagino Lakes it was possible to conduct the snow survey in "Buran" traverses 16.6 and 17.5 km long, as the expedition worked at these lakes for several days. At those locations where measurements had been made by using AN-2 aircraft for transport there was not enough time for snow measuring traverses of more than 0.5 km. These short traverses were made in such a way as to reflect the snow accumulation conditions at different relief forms. Usually, the snow survey began on the ice of rivers or lakes leading through the edge of the valley to the water boundary. At short traverses the snow cover depth was determined by a stake and pits every 10 m and the snow density every 100 m.

At each of the 26 traverses, several pits were dug from 0.5 m to 3.0 m deep. In the pits where snow was sampled for determining concentrations of heavy metals and organochlorines, the snow cover structure was also described.

Snow sampling was uniform over the entire plane of a specially cleaned pit side. By means of the methods developed at the Regional Center "Monitoring of the Arctic" (RCMA), snow samples for determining organochlorines were placed into a metal cylinder, and for determining heavy metals into a plastic cylinder. After sampling, both cylinders were placed into a wooden box and put indoors and melted there for 2-3 days. Then the water from cylinders was poured into glass and plastic flasks, respectively. Water samples were then frozen.

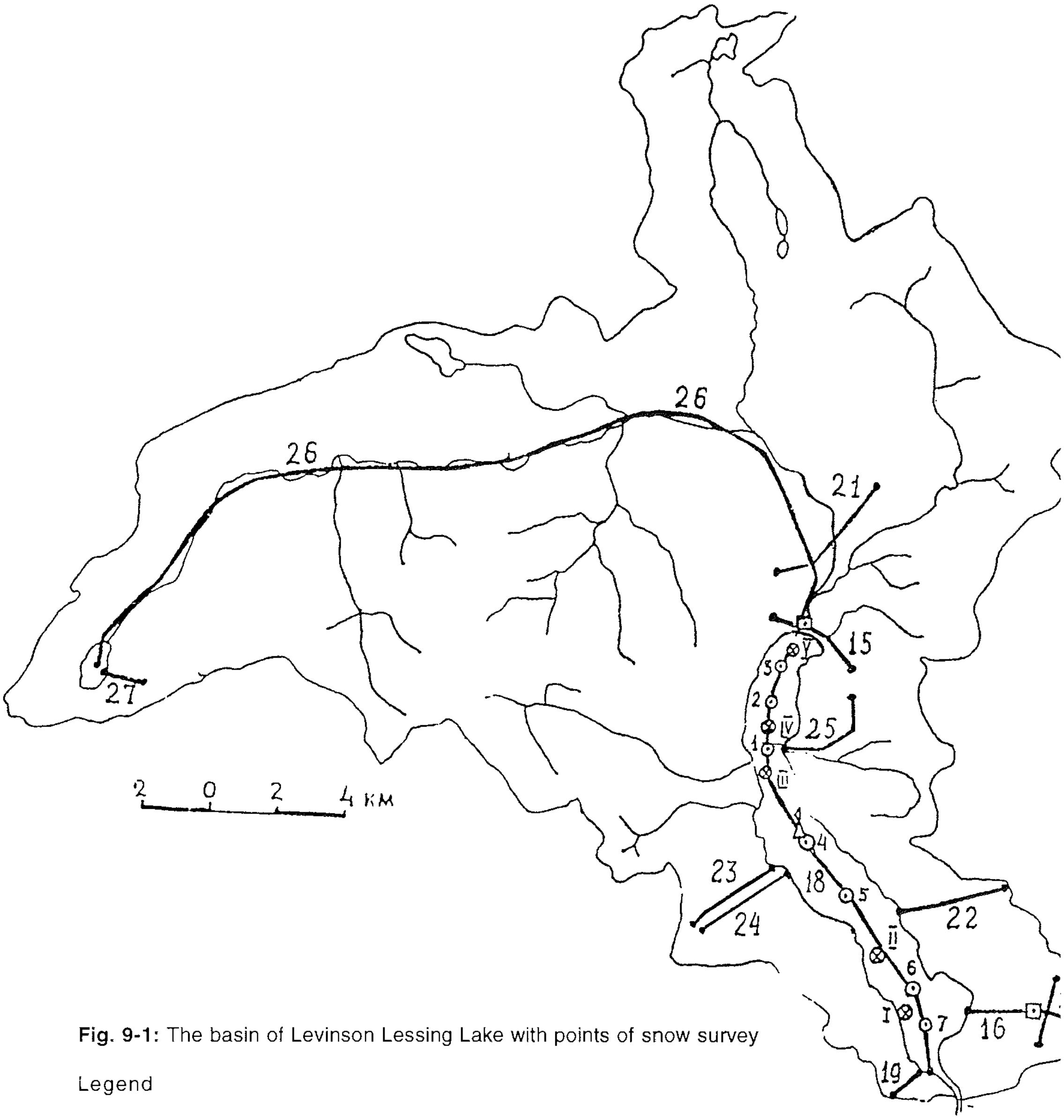


Fig. 9-1: The basin of Levinson Lessing Lake with points of snow survey

Legend

18 - snow survey route

⊗ III - sampling points of lake ice

⊙ 2 - sampling points of snow on lake ice

⊡ - sampling point for determining the concentration of pollutants

Table 9-1: Results of the snow survey on Taymyr Pensinsula

Route No.	Date	Average snow thickness (cm)	Average density g/ccm	Reserve of water (mm)	Length of route (km)
1	4.05	53	0.25	132.5	0.35
2	5.05	50	0.26	130	16.6
3	11.05	39	0.31	120.9	17.5
4	reserve				
5	16.05	52	0.34	176.8	0.4
6	16.05	45	0.28	126	0.4
7	16.05	38	0.29	110.2	0.4
8	16.05	49	0.31	151.9	0.4
9	16.05	58	0.29	168.2	0.3
10	18.05	27	0.27	72.9	0.5
11	18.05	31	0.33	102.3	0.4
12	18.05	37	0.22	81.4	0.4
13	19.05	38	0.26	98.8	0.3
14	19.05	39	0.26	101.4	0.33
15	23.05	17	0.31	52.7	4.15
16	25.05	51	0.37	188.7	3.35
17	25.05	37	0.27	99.9	5.95
18	26.05	33	0.36	111.8	15.2
	1.06				
19	26.05	52	0.30	156	2
20	26.05	32	0.30	96	2
21	26.05	40	0.37	148	6.3
	1.06				
22	28.05	66	0.32	211.2	3
23	28.05	77	0.45	346.5	3.4
24	28.05	28	0.32	89.6	3.65
25	29.05	95	0.36	342	5.1
26	6.06	63	0.41	258.3	31.4
27	6.06	34	0.26	88.4	1.7

9.2.1 Ecological and ecological-hygienic studies
(Yu. S. Scherbakov and P. V. Seleznev)

In accordance with the work plan under NTP Project 4.5 of the AARI" "To investigate the current state of anthropogenic impacts on the environment in the regions of autonomous settlements in the Russian Arctic and to reveal typical features in spreading of these impacts depending on the character and intensity of pollution factors", in July-August 1995 the expedition A-162-A conducted sampling and analysis of water and ground for the ecological-hygienic assessment of anthropogenic pollution of the territories located in the vicinity of the Khatanga river (Novaya, Kresty, Khatanga, Zhdanikha settlements), as well as of the Taymyr Lake settlement and the Makeyev Base at the Taymyr lake. Sampling was performed for determining the following characteristics.

1. Indicators of the sanitary-bacteriological and epidemiological state of natural environemntal compartments (in ground and water samples):
- the total microbic amount;
- the amount of bacteria of the intestinal bacillus;
- the amount of psichrophilous bacteria;
- the amount of thermophilous bacteria;
- bacteria decomposing oil products.

2. Sanitary-chemical indicators of the state of water bodies;
- silicon;
- nitrite nitrogen, ammonium nitrogen;
- dissolved oxygen;
- biological oxygen demand;
- oxidability (permanganate);
- content of oil products,
- pH.

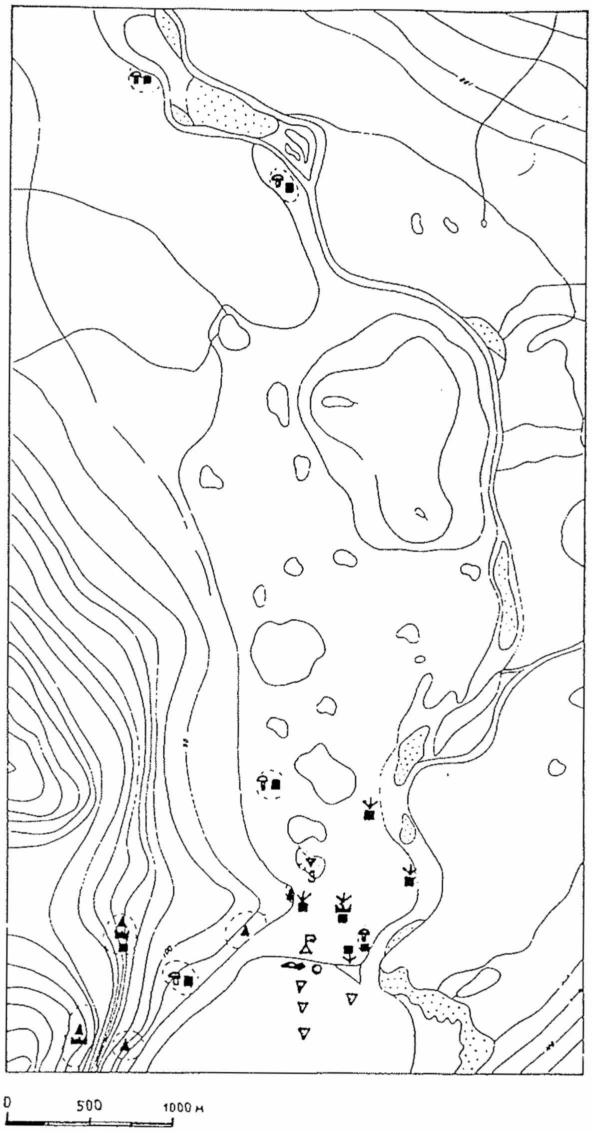
A sampling list of ground for estimating the sanitary-bacteriological pollution of the territory of autonomous polar settlements is shown in the Annex (Tab. 11.1-9).

9.2.2 Radioecological studies
(O. Panasenkova)

During July 15 to September 1, 1995 within the framework of the AARI Program for investigating the state of the lake-river systems and their changes under the influence of anthropogenic impacts, the Laboratory for Radioecology of the Arctic and the North of RINCAN carried out sampling of soil, water and bottom sediments and biota on Taymyr peninsula in the region of the Levinson-Lessing Lake in order to obtain evidence on the pollution of this region by natural (NRN) and artificial radionuclides (ARN).
Sampling in the study region was aimed not only to obtain information of the radionuclide level in separate natural media and biota, but also to investigate the transport of NRN and ARN based on separate links of the trophic chains of terrestrial and water ecosystems.
For assessing the state of ARN pollution of the terrestrial ecosystem links, the

following number of samples were collected: soil (10), lichen (4), moss (3), fungi (5), higher vegetation (6) (Fig. 9-2). Among terrestrial mammals, the northern reindeer was selected as the main object for control, as the northern reindeer is one of the main food types of the indigenous peoples of the North.
Samples of vegetation are represented by the following communities: cotton-sedge-grass (*Eriophorum vaginatum, Carex aquatilis ssp., Arctophila fulva*), moss-herb-shrub (*Dryas octopetala ssp. punctata*), moss-shrub (*Cassiope tetragona*), sedge-moss, herb-grass (*Astagalus umbellatus, Poa prateusis, ssp. colpodea, ssp. alpigena*). They were sampled from different landscape contoures: the flood-plain of the Krasnaya river, turf covered relic slopes, polygonal tundra, the destructed shore of the Krasnaya river, supermoistured debris cones. In the presence of a stable herbage, sampling of plants was over 1 m^2 and at a lighted herbage smaller sites of 0.25 m^2 were used, but their number was 4 times increased. One to two dominating types of the plants constituting a mixed specimen were indicated in the collected vegetation sample.
Lichen (*Cetrariella delisei, Dactylina Arctica, Tamnolia vermicularis, Asahinea chrysantha*) and moss (*Andreaca rupestris var. papilosa, Racomitricum lanuginosum, Cinelidium Arcticum, Calliergon giganteum, Drepanocladus revolver*) were sampled in herb-moss-lichen-shrub (*Drias actopetala, ssp.punctata, Cassiope tetragona, Salix polaris, Novosivversia glacialis*) punctated tundras at above lake terraces, debris cones and mountain slopes, as well as in moss-lichen punctated tundras among rock streams in the nival situation. Sampled soil lichen and moss are the dominant species both for the given vegetation communities and on the whole for the transient zone between typical and Arctic tundras which includes the study region. At present there is no convincing evidence on species differences in accumulating ARN by lichen and moss, hence several species differing in biological properties and habitat conditions were taken for studies.
Fungi were sampled taking into account the possibilities for comparing the results of studies for determining ARN levels with data of the other regions of the North, as well as temperate regions of Russia.

Sampling of soils was linked to the sampling of lichen, moss, fungi and higher plants. This will allow consideration and quantitative estimates of the value of the ARN transport from soil to the acceptory links of the trophic chains.
For estimating the ARN pollution state of the water ecosystem of the Levinson-Lessing Lake, samples of media and biota were collected: water (4), bottom sediments (7), bone (9) and muscle (3) tissue of fishes.
Cesium-137 was extracted from large water volumes (70-100 l) at the carrier in the form of mixed ferrocyanides of potassium and nickel.
Evidence on the level of radionuclides in bottom sediments is necessary for calculating the balance of radionuclides in the water body. For analysis, bottom sediments (surface layer of 10 cm) from different depths and with a different content of organics were sampled.
For radiological studies of ichtyofauna of the lake, sampling of bone tissues of the representatives of the main trophic groups was performed for considering transfer of radionuclides via the food chain. Also, bone tissue was sampled for revealing age and sex differences in accumulation. The muscle tissue is necessary for comparing with the bone tissue.



collection/selection sites/localities/points of :

fish, algae, mushrooms, lichens, mosses,

phanerogamic plants, sediments, water, soil

Fig. 9-2: The map of radioecological sampling

In addition, as control points and for comparing the material, samples of bone and muscle tissue of fishes from the Labaz Lake, muscle tissue of fishes from the Taymyr Lake and from the zone of the confluence of the Upper Taymyra and Logata rivers were collected.
Radiological studies were also conducted in the thermokarst lake of 50 m in diameter and a mean depth of 0.70 m which is a typical component of the tundra landscape bottom sediments, algae and coastal vegetation were sampled there.
A selective analysis for radioactivity of the expedition samples was carried out at the Laboratory for Radioecology of the Arctic and the North (RINCAN). A list of samples is given in the Annex (Tab. 11.1-10).
Concentrations of Cs-137 in soil and biota indicate a global and low level of pollution of the study region by this radionuclide. The highest concentration is observed in the muscle of reindeer (45 Bq/kg), but this concentration is below the values recorded in muscles of reindeers inhabiting the European part of the Russian North.
The content of natural radionuclides K-40, Ra-226, Th-228 in soil and biota is within the radiochemical background value.

9.3 The ITEX site
(J. Boike and M. Sommerkorn)

As a continuation of 1994 (Boike and Sommerkorn, 1995), measurements of active layer thaw depths within 100x100 m polygon were carried out at Levinson Lessing and Labaz Lake as a part of the International Tundra Experiment (ITEX).
The active layer thaw depth of Levinson Lessing and Labaz Lake, respectively, are presented in tables 9-4 and 9-5 and in tables 9-6 and 9-7. The climate data from adjacent climate stations are summarized.

Table 9-4: Active layer thaw depth of 1995 at the Levinson Lessing Lake ITEX site

Date	average thaw depth (cm)	standard deviation	n
28.6.	14,7	2,9	200
01.7.	20,4	3,3	200
05.7.	17,0	5,0	200
18.7.	25,0	3,2	200
26.7.	29,5	3,5	200
02.8.	33,5	3,6	200
09.8.	35,4	3,5	200
16.8.	37,5	4,0	200
23.8.	39,9	4,2	200
29.8.	41,9	4,3	200

Table 9-5: 1995 climate data for the Levinson Lessing Lake ITEX site

	times recorded	average air temperature (°C)	maximum air temperature (°C)	minimum air temperature (°C)
May	21.-31.	-2,3	1,5	-10,2
June	1.-7., 16.-30.	3,0	15,9	-5,0
July	1.-31.	9,9	18,3	0,6
August	1.-31.	8,9	19,6	0,0

Table 9-6: Active layer thaw depth of 1995 at the Labaz Lake ITEX site

Date	average thaw depth (cm)	standard deviation	n
25.8.	50,0	5,1	40

Table 9-7: 1995 climate data for the Labaz Lake ITEX site

	times recorded	average air temperature (°C)	maximum air temperature (°C)	minimum air temperature (°C)
July	20.-31.	12,8	23,1	4,7
August	1.-25.	10,6	23,2	-2,6

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11 ANNEX

11.1 List of samples and stations

Table 11.1-1: Samples for isotopic analysis collected in the Labaz Lake area during the expedition "Taymyr-1995"

Sample no.	Study site	Depth [m]	Type of analysis			Character of the sample	Conductivity [µS/cm]
			O-18	H-2	H-3		
Is-95-1	river valley	0,45	x	x	x	snow field, 23.07.1995	8,16
Is-95-2	river valley	0,21	x	x	x	snow field, 23.07.1995	2,02
Is-95-3	river valley	0,00	x	x	x	snow field, 23.07.1995	9,92
Is-95-4	Tolton river		x	x	x	river water, 23.07.1995	29,30
Is-95-5	LAB 2-95	0,60	x	x		segregated ice	
Is-95-6	LAB 2-95	0,92	x	x		segregated ice	
Is-95-7	LAB 2-95	1,04	x	x		segregated ice	
Is-95-8	LAB 2-95	1,22	x	x		segregated ice	
Is-95-9	LAB 3-95	1,46	x	x		segregated ice	
Is-95-10	LAB 3-95	1,57	x	x		segregated ice	57,9
Is-95-11	LAB 3-95	1,73	x	x		segregated ice	36,4
Is-95-12	LAB 3-95	1,80	x	x		segregated ice	49.4
Is-95-13	LAB 3-95	1,92	x	x		segregated ice	53,1
Is-95-14	LAB 3-95	2,02	x	x		segregated ice	266
Is-95-15	LAB 3-95	2,10	x	x		segregated ice	215
Is-95-16	LAB 3-95	2,15	x	x		segregated ice	284
Is-95-17	LAB 3-95	2,26	x	x		segregated ice	163,5
Is-95-18	LAB 3-95	2,31	x	x		segregated ice	
Is-95-19	LAB 3-95	2,40	x	x		segregated ice	48,8
Is-95-20	LAB 3-95	2,50	x	x		segregated ice	102
Is-95-21	LAB 3-95	2,60	x	x		segregated ice	
Is-95-22	LAB 4-95	0,85	x	x		segregated ice	238
Is-95-23	LAB 4-95	1,00	x	x		segregated ice	241
Is-95-24	LAB 5-95	0,65	x	x		segregated ice	
Is-95-25	LAB 6-95	0,60	x	x		segregated ice	217
Is-95-26	LAB 6-95	0,70	x	x		segregated ice	249
Is-95-27	LAB 6-95	0,80	x	x		segregated ice	603
Is-95-28	LAB 6-95	0,90	x	x		segregated ice	593
Is-95-29	LAB 6-95	1,05	x	x		segregated ice	729
Is-95-30	LAB 6-95	1,20	x	x		segregated ice	699
Is-95-31	LAB 6-95	1,30	x	x		ice wedge	134,9

Sample no.	Study site	Depth [m]	Type of analysis			Character of the sample	Conductivity [µS/cm]
			O-18	H-2	H-3		
Is-95-32	LAB 6-95	1,43	x	x		ice wedge	136,1
Is-95-33	LAB 6-95	1,52	x	x		ice wedge	143,4
Is-95-34	LAB 6-95	1,65	x	x		ice wedge	115,2
Is-95-35	LAB 6-95	1,72	x	x		ice wedge	108,3
Is-95-36	LAB 6-95	1,88	x	x		ice wedge	103,9
Is-95-37	LAB 7-95	0,60	x	x		segregated ice	448
Is-95-38	LAB 7-95	0,70	x	x		segregated ice	509
Is-95-39	LAB 7/2-95	0,67	x	x		segregated ice	535
Is-95-40	LAB 8-95	0,60			x	segregated ice	134
Is-95-41	LAB 8-95	0,87	x	x	x	segregated ice	263
Is-95-42	LAB 8-95	0,95			x	segregated ice	259
Is-95-43	LAB 8-95	1,10			x	segregated ice	312
Is-95-44	LAB 8-95	1,20			x	segregated ice	270
Is-95-45	LAB 8-95	1,30			x	segregated ice	234
Is-95-46	LAB 8-95	1,35	x	x	x	segregated ice	400
Is-95-47	LAB 8-95	1,45	x	x	x	segregated ice	327
Is-95-48	LAB 8-95	1,60	x	x	x	segregated ice	312
Is-95-49	LAB 8-95	1,70			x	segregated ice	302
Is-95-50	LAB 8-95	1,85	x	x	x	segregated ice	429
Is-95-51	LAB 8-95	2,00	x	x	x	segregated ice	359
Is-95-52	LAB 9-95	0,63	x	x		segregated ice	396
Is-95-53	LAB 9/2-95	0,70			x	segregated ice	545
Is-95-54	LAB 9-95	0,80	x	x		segregated ice	573
Is-95-55	LAB 9/2-95	0,84			x	segregated ice	508
Is-95-56	LAB 9-95	0,85	x	x		segregated ice	769
Is-95-57	LAB 9/2-95	0,95			x	segregated ice	287
Is-95-58	LAB 9/2-95	1,10	x	x	x	ice wegde	108,3
Is-95-59	LAB 9/2-95	1,20	x	x	x	ice wegde	80,8
Is-95-60	LAB 9/2-95	1,30	x	x	x	ice wegde	72,5
Is-95-61	LAB 9/2-95	1,40	x	x	x	ice wegde	87,5
Is-95-62	LAB 9/2-95	1,50	x	x	x	ice wegde	97,2
Is-95-63	LAB 9/2-95	1,60	x	x	x	ice wegde	75,2
Is-95-64	LAB 9/2-95	1,70	x	x	x	ice wegde	93,9
Is-95-65	LAB 10-95	0,86			x	segregated ice	312

Sample no.	Study site	Depth [m]	Type of analysis			Character of the sample	Conductivity [µS/cm]
			O-18	H-2	H-3		
Is-95-66	LAB 10-95	0,95			x	segregated ice	425
Is-95-67	LAB 10-95	1,08			x	segregated ice	425
Is-95-68	LAB 10-95	1,23			x	segregated ice	664
Is-95-69	LAB 10-95	1,40			x	segregated ice	825
Is-95-70	LAB 10-95	1,60	x	x	x	segregated ice	522
Is-95-71	LAB 10-95	1,78			x	segregated ice	566
Is-95-72	LAB 10-95	1,87			x	segregated ice	518
Is-95-73	LAB 10-95	2,00			x	segregated ice	332
Is-95-74	LAB 10-95	2,20			x	segregated ice	180,2
Is-95-75	LAB 11-95	0,60	x	x		segregated ice	283
Is-95-76	LAB 11-95	0,70	x	x		segregated ice	219
Is-95-77	LAB 11-95	0,84	x	x		segregated ice	175,2
Is-95-78	LAB 11-95	0,95	x	x		segregated ice	260
Is-95-79	LAB 11-95	1,20	x	x		segregated ice	426
Is-95-80	LAB 11-95	1,36	x	x		segregated ice	455
Is-95-81	LAB 11-95	1,48	x	x		segregated ice	728
Is-95-82	LAB 11-95	1,55	x	x		segregated ice	
Is-95-83	LAB 11-95	1,60	x	x		segregated ice	666
Is-95-84	LAB 11-95	1,75	x	x		segregated ice	790
Is-95-85	LAB 11-95	1,90	x	x		ice wedge	236
Is-95-86	LAB 11-95	2,10	x	x		ice wedge	98,0
Is-95-87	LAB 12-95	0,45	x	x		segregated ice	133,6
Is-95-88	LAB 12-95	0,68	x	x		segregated ice	129,7
Is-95-89	LAB 12-95	0,84	x	x		segregated ice	259
Is-95-90	LAB 12-95	0,90	x	x		segregated ice	162,8
Is-95-91	LAB 12-95	1,00	x	x		segregated ice	264
Is-95-92	LAB 12-95	1,20	x	x		segregated ice	368
Is-95-93	LAB 12-95	1,30	x	x		segregated ice	706
Is-95-94	LAB 12-95	1,47	x	x		segregated ice	506
Is-95-95	LAB 12-95	1,60	x	x		segregated ice	673
Is-95-96	LAB 12-95	1,70	x	x		segregated ice	927
Is-95-97	LAB 12-95	1,90	x	x		segregated ice	985
Is-95-98	LAB 12-95	2,05	x	x		segregated ice	1013
Is-95-99	LAB 12-95	2,20	x	x		ice wedge	83,3

Sample no.	Study site	Depth [m]	Type of analysis			Character of the sample	Conductivity [µS/cm]
			O-18	H-2	H-3		
Is-95-100	LAB 12-95	2,30	x	x		ice wedge	94,4
Is-95-101	LAB 12-95	2,40	x	x		ice wedge	100
Is-95-102	LAB 13-95	0,60			x	segregated ice	203
Is-95-103	LAB 13-95	0,70			x	segregated ice	204
Is-95-104	LAB 13-95	0,82			x	segregated ice	260
Is-95-105	LAB 13-95	0,96			x	segregated ice	256
Is-95-106	LAB 13-95	1,10			x	segregated ice	339
Is-95-107	LAB 13-95	1,25			x	segregated ice	471
Is-95-108	LAB 13-95	1,45			x	segregated ice	477
Is-95-109	LAB 13-95	1,55			x	segregated ice	482
Is-95-110	LAO 18-95	1,5-2,0	x	x	x	ice wedge	67,7
Is-95-111	LAO 20-95	5,50	x	x	x	segregated ice	227
Is-95-112	LAO 15-95	sampling point 1	x	x	x	ice wedge	66,1
Is-95-113	LAO 15-95	sampling point 2	x	x	x	ice wedge	18,82
Is-95-114	LAO 15-95	sampling point 3	x	x	x	ice wedge	40,5
Is-95-115	LAO 15-95	sampling point 4	x	x	x	ice wedge	32,3
Is-95-116	LAO 15-95	sampling point 5	x	x	x	ice wedge	40,9
Is-95-117	LAO 8-95	sampling point 1	x	x	x	ice wedge	105,8
Is-95-118	LAO 22-95	6,30	x	x	x	small ice wedge	
Is-95-119	LAO 6-95	3,40	x	x	x	segregated ice	
Is-95-120	LAO 6-95	3,60	x	x	x	segregated ice	
Is-95-121	LAO 6-95	3,80	x	x	x	segregated ice	
Is-95-122	LAO 6-95	4,00	x	x	x	segregated ice	
Is-95-123	LAO 6-95	4,20	x	x	x	segregated ice	
Is-95-124	LAO 6-95	4,50	x	x	x	segregated ice	
Is-95-125	LAO 6-95	4,70	x	x	x	segregated ice	
Is-95-126	LAO 6-95	5,00	x	x		segregated ice	
Is-95-127	LAO 6-95	5,20	x	x		segregated ice	
Is-95-128	LAO 6-95	5,40	x	x	x	segregated ice	
Is-95-129	LAO 6-95	5,70	x	x	x	segregated ice	
Is-95-130	LAO 6-95	6,00	x	x	x	segregated ice	
Is-95-131	LAO 6-95	6,40	x	x	x	segregated ice	
Is-95-132	LAO 6-95	6,80	x	x	x	segregated ice	
Is-95-133	LAO 24-95	sampling point 1	x	x	x	buried glacier ice	28,7

Sample no.	Study site	Depth [m]	Type of analysis			Character of the sample	Conductivity [µS/cm]
			O-18	H-2	H-3		
Is-95-134	LAO 24-95	sampling point 2	x	x	x	buried glacier ice	69,9
Is-95-135	LAO 24-95	sampling point 3	x	x	x	buried glacier ice	48,8
Is-95-136	LAO 24-95	sampling point 4	x	x	x	buried glacier ice (enriched with mineral particles)	127,8
Is-95-137	LAO 24-95	sampling point 5	x	x	x	buried glacier ice	20,9
Is-95-138	LAO 24-95	sampling point 6	x	x	x	buried glacier ice	11,1
Is-95-139	LAO 24-95	sampling point 7	x	x	x	buried glacier ice	20,4
Is-95-140	LAO 24-95	sampling point 8	x	x	x	buried glacier ice	29,3
Is-95-141	LAO 24-95	sampling point 9	x	x	x	buried glacier ice	14,1
Is-95-142	LAO 24-95	sampling point10	x	x	x	contact buried glacier ice/ ice-ground	355
Is-95-143	LAO 24-95	sampling point 11	x	x	x	buried glacier ice	45,9
Is-95-144	LAO 24-95	sampling point 12	x	x	x	overlaying ice-ground	2200
Is-95-145	LAB 14-95	0,50	x	x		segregated ice	187,2
Is-95-146	LAB 14-95	1,25	x	x		intrusive ? ice with angular silt fragments	196,7
Is-95-147	LAB 14-95	1,40	x	x	x	intrusive ? ice with angular silt fragments	316
Is-95-148	LAB 14-95	1,55	x	x	x	intrusive ? ice with angular silt fragments	232
Is-95-149	LAB 14-95	1,70	x	x	x	intrusive ? ice with angular silt fragments	186,3
Is-95-150	LAB 14-95	1,80	x	x	x	intrusive ? ice with angular silt fragments	315
Is-95-151	LAB 14-95	2,00	x	x	x	intrusive ? ice with angular silt fragments	282
Is-95-152	LAB 14-95	2,10	x	x	x	intrusive ? ice with angular silt fragments	218
Is-95-153	LAB 14-95	2,30	x	x	x	intrusive ? ice with angular silt fragments	238
Is-95-154	LAB 14-95	2,45	x	x	x	intrusive ? ice with angular silt fragments	209
Is-95-155	LAB 14-95	2,50	x	x	x	intrusive ? ice with angular silt fragments	158,1
Is-95-156	LAB 14-95	2,65	x	x	x	intrusive ? ice with angular silt fragments	203
Is-95-157	LAB 14-95	2,80	x	x	x	intrusive ? ice with angular silt fragments	212
Is-95-158	LAB 14-95	2,98	x	x	x	intrusive ? ice with angular silt fragments	180,1
Is-95-159	LAB 14-95	3,20	x	x	x	intrusive ? ice with angular silt fragments	218
Is-95-160	LAB 14-95	3,65	x	x	x	intrusive ? ice with angular silt fragments	106,1
Is-95-161	LAB 14-95	3,75	x	x	x	pure intrusive ? ice	11,94
Is-95-162	LAB 14-95	3,90	x	x	x	intrusive ? ice with angular silt fragments	127
Is-95-163	LAB 14-95	4,00	x	x	x	intrusive ? ice with angular silt fragments	122,7
Is-95-164	LAB 14-95	4,35	x	x	x	pure intrusive ? ice	9,05
Is-95-165	LAB 14-95	4,55	x	x	x	pure intrusive ? ice	8,47
Is-95-166	LAB 14-95	4,70	x	x	x	pure intrusive ? ice	18,85

Sample no.	Study site	Depth [m]	Type of analysis			Character of the sample	Conductivity [µS/cm]
			O-18	H-2	H-3		
Is-95-167	LAB 14-95	4,80	x	x	x	pure intrusive ? ice	6,86
Is-95-168	LAB 14-95	5,00	x	x	x	pure intrusive ? ice	12,58
Is-95-169	LAB 14-95	5,10	x	x	x	pure intrusive ? ice	28,5
Is-95-170	LAB 14-95	5,30	x	x	x	intrusive ? ice with angulare silt fragments	333
Is-95-171	LAB 14-95	5,40	x	x		intrusive ? ice with angulare silt fragments	319
Is-95-172	LAB 14-95	5,55	x	x		intrusive ? ice with angulare silt fragments	
Is-95-173	LAB 14-95	5,70	x	x		intrusive ? ice with angulare silt fragments	227
Is-95-174	LAB 9/3	1,05	x	x		top site of the ice wedge	
Is-95-175	LAB 9/3	1,25	x	x	x	ice wedge with inclusions of peaty ground	70,9
Is-95-176	LAB 9/3	1,40	x	x	x	ice wedge with inclusions of peaty ground	78,8
Is-95-177	LAB 9/3	1,50	x	x	x	ice wedge with inclusions of peaty ground	62,9
Is-95-178	LAB 9/3	1,60	x	x	x	ice wedge with inclusions of peaty ground	
Is-95-179	LAB 9/3	1,75	x	x	x	ice wedge with inclusions of peaty ground	128,1
Is-95-180	LAB 9/3	1,90	x	x	x	ice wedge with inclusions of peaty ground	85,5
Is-95-181	LAB 9/3	2,00	x	x	x	ice wedge with inclusions of peaty ground	79,4
Is-95-182	LAB 9/3	2,15	x	x	x	ice wedge with inclusions of peaty ground	78,5
Is-95-183	LAB 9/3	2,30	x	x	x	ice wedge without inclusions	73,4
Is-95-184	Tolton river		x	x	x	river water, 23.08.1995	
Is-95-185	Labaz lake		x	x	x	lake water, 23.08.1995	
Is-95-186	LAO 29	sampling point 1	x	x	x	buried glacier ice (at the upper contact layer)	
Is-95-187	LAO 29	sampling point 2	x	x	x	buried glacier ice (at the lateral contact)	
Is-95-188	LAO 29	sampling point 3	x	x	x	buried glacier ice (central part of the ice body)	
Is-95-189	LAO 29	sampling point 4	x	x	x	buried glacier ice (at the left lateral contact)	
Is-95-190	LAO 29	sampling point 5	x	x	x	buried glacier ice (upper part of the ice body)	

Table 11.1-2: Samples for analysis of water soluble compounds

Sample no.	Site no.	Depth [m]	Sample description	Remark
WL-1	LAB 1-95	1,00	sand with ice cement	top of frozen ground
WL-2	LAB 2-95	0,45	sandy loam with plant remains, with ice lenses	top of frozen ground
WL-3	LAB 2-95	0,60	sandy loam with ice lenses	
WL-4	LAB 2-95	0,64	loamy fine sand with plant remains, with ice lenses	
WL-5	LAB 2-95	0,77	clay loam enriched with plant remains, with ice lenses	
WL-6	LAB 2-95	1,12	layered sandy loam with plant remains, with ice lenses	
WL-7	LAB 2-95	1,37	sandy loam with fine plant remains, with rare ice lenses	
WL-8	LAB 2-95	1,70	sandy loam enriched with plant remains, with ice lenses	
WL-9	LAB 2-95	1,87	sandy loam enriched with plant remains, with ice lenses	
WL-10	LAB 2-95	1,95	layered coarse sand with ice cement	
WL-11	LAB 4-95	0,70	loam with reddish iron oxide spots	thawed ground
WL-12	LAB 4-95	0,70	loam with fine ice lenses	frozen ground
WL-13	LAB 4-95	0,90	loam enriched with ice lenses	
WL-14	LAB 5-95	0,62	loam enriched with ice lenses	
WL-15	LAB 6-95	0,60	loam with plant remains, with ice lenses	
WL-16	LAB 6-95	1,07	sandy loam enriched with ice lenses	ice wedge contact zone
WL-17	LAB 7-95	0,15	sandy loam	
WL-18	LAB 7-95	0,60	sandy loam with plant remains, with ice lenses	top of frozen ground
WL-19	LAB 7-95	0,67	sandy loam with gravel and pebble stones, ice-rich	
WL-20	LAB 8-95	0,60	loam with coarse ice lenses	top of frozen ground
WL-21	LAB 8-95	1,10	layered sandy loam with plant remains, with ice lenses	
WL-22	LAB 8-95	1,60	loam with plant remains, very ice-rich ("ice-ground")	
WL-23	LAB 8-95	1,85	sandy loam with rare reddish iron oxide spots, ice-rich	
WL-24	LAB 9-95	0,20	loam	
WL-25	LAB 9-95	0,63	sandy loam with ice lenses	top of frozen ground
WL-26	LAB 9/2-95	0,70	loamy sand with reddish iron oxide spots, with plant remains	
WL-27	LAB 10-95	0,15	loam	
WL-28	LAB 10-95	0,75	loamy sand with gravel, with ice lenses	top of frozen ground
WL-29	LAB 10-95	0,95	loamy sand with gravel, with ice lenses	
WL-30	LAB 10-95	1,23	loamy sand with nodes of humic organic soil, with rare ice lenses	
WL-31	LAB 10-95	1,60	loamy sand with gravel and pebbles, with ice lenses	
WL-32	LAB 10-95	1,78	loamy sand with gravel and wood remains, with ice lenses	
WL-33	LAB 10-95	2,00	layered loamy sand with gravel and rare pebbles, with ice lenses	

Sample no.	Site no.	Depth [m]	Sample description	Remark
WL-34	LAB 11-95	0,15	loam with roots and other plant remains	
WL-35	LAB 11-95	0,60	loamy sand with ice lenses	top of frozen ground
WL-36	LAB 12-95	0,15	loam with roots and other plant remains	
WL-37	LAB 13-95	0,15	loam with roots and plant remains	
WL-38	LAB 12/2-95	0,60	loam, very ice-rich ("ice-ground")	top of frozen ground
WL-39	LAB 12/2-95	0,70	loam, very ice-rich	
WL-40	LAB 12/2-95	0,85	ice with mineral layers	
WL-41	LAB 12/2-95	1,00	very ice-rich loam with wood remains	
WL-42	LAB 12/2-95	1,10	very ice-rich loam with wood remains	
WL-43	LAB 12/2-95	1,20	peaty sandy loam, very ice-rich ("ice-ground")	
WL-44	LAB 12/2-95	1,35	peaty sandy loam, very ice-rich ("ice-ground")	
WL-45	LAB 12/2-95	1,45	peaty sandy loam, very ice-rich ("ice-ground")	
WL-46	LAB 12/2-95	1,60	peaty sandy loam, very ice-rich ("ice-ground")	
WL-47	LAB 12/2-95	1,80	peaty sandy loam, very ice-rich ("ice-ground")	
WL-48	LAB 12/2-95	1,90	peaty sandy loam with wood remains, with ice lenses	
WL-49	LAB 12/2-95	1,95	peaty sandy loam with wood remains, with ice lenses	
WL-50	LAB 12/2-95	2,00	peaty sandy loam with root and wood remains, very ice-rich	ice wedge contact zone
WL-51	LAB 12/2-95	2,10	massive ice (ice wedge) with mineral inclusions	
WL-52	LAB 11/2-95	0,5	sandy loam, very ice-rich ("ice-ground")	
WL-53	LAB 11/2-95	0,80	sandy loam with fine plant remains, ice-rich	
WL-54	LAB 11/2-95	0,90	sandy loam with fine plant remains, ice-rich	
WL-55	LAB 11/2-95	1,00	sandy loam with fine plant remains, ice-rich	
WL-56	LAB 11/2-95	1,15	sandy loam with rare plant remains, ice-rich	
WL-57	LAB 11/2-95	1,30	loamy sand with rare plant remains, with ice lenses	
WL-58	LAB 11/2-95	1,50	loamy sand with ice lenses	
WL-59	LAB 11/2-95	1,65	loamy sand with ice lenses	
WL-60	LAB 11/2-95	1,80	loamy sand with rare gravel, with ice lenses	
WL-61	LAB 11/2-95	1,95	loamy sand enriched pland remains, with ice lenses	
WL-62	LAB 11/2-95	2,15	sand with reddish iron oxid spots, plant remains, ice-rich	
WL-63	LAB 9/3-95	0,70	peaty loam with gravel and pebbles, with ice lenses	
WL-64	LAB 9/3-95	0,75	peaty loam with gravel and pebbles, with ice lenses	
WL-65	LAB 9/3-95	0,80	peaty loam with gravel and pebbles, with ice lenses	
WL-67	LAB 9/3-95	0,85	peaty loam with gravel and pebbles, with ice lenses	
WL-68	LAB 9/3-95	0,95	peaty loam with gravel and pebbles, with ice lenses	
WL-69	LAB 9/3-95	1,00	peaty loam with gravel and pebbles, with ice lenses	
WL-70	LAB 9/3-95	1,02	sand, with ice cement	

Table 11.1-3: Samples collected in the Labaz Lake area for radiocarbon dating

Nr.	Sampling point	Character of sample	Estimated age, yr BP
S95-1	Surface of lake terrace near LAB 2-95	tree remain (Larix) in situ	<10.000
S95-2	LAB 2-95; 0,92-1,04 m	wood remains from peat bedd	<10.000
S95-3	LAB 3-95; 0,3-0,6 m	peat	<10.000
S95-4	LAB 12-95	wood remains from peat bedd	<10.000
S95-5	LAO 18-95; 1,0 m	wood remains from ice wedge surface	<10.000
S95-6	LAO 18-95; 1,0-1,1 m	root remains from covering layer of ice wedges	<10.000
S95-7	LAO 15-95; 0,8 m	wood remains from covering layer of ice wedges	<10.000
S95-8	LAO 15-95; 0,8 m	wood remains from covering layer of ice wedges	<10.000
S95-9	Surface of lake terrace near LAB 13-95	tree remain (Larix) in situ	<10.000
S95-10	LAO 1-95, Profil 1; 0,45-0,85 m	peat, haevy decomposed	> 40.000
S95-11	LAO 1-95, Profil 1; 0,85-1,20 m	peat with moderately decomposed	> 40.000
S95-12	LAO 1-95, Profil 1; 1,20-1,45 m	weakly decomposed peat with wood remains	> 40.000
S95-13	LAO 1-95, Profil 1; 1,20-1,45 m	wood remains from peat bedd	> 40.000
S95-14	LAO 1-95, Profil 2;1,5-1,6 m	small plant remains from sand layer	> 40.000
S95-15	LAO 22-95; 2,5-2,7 m	wood remains	30.-40.000
S95-16	LAO 22-95; 5,7-6,1 m	wood remains	30.-40.000
S95-17	LAO 22-95; 6,4 m	wood remains from a fossile frost cracke	30.-40.000
S95-18	LAO 22-95; 6,8-7,2 m .	wood remains	30.-40.000
S95-19	LAO 21-95; 0,87 m .(~ 2,5 m above.Labaz)	peat	<10.000
S95-20	LAO 6-95; 3,4-3,6 m	small plant remains from lake sediments	30.-40.000
S95-21	LAO 6-95; 6,6-6,86 m	small plant remains from lake sediments	30.-40.000
S95-22	Thermocirque westlich von LA-O24	tree remain	<10.000
S95-23	LAO 25-95; 2,8 m	peat with wood remains	>40.000
S95-24	LAO 25-95; 3,5 m	peat with wood remains	>40.000
S95-25	LAO 25-95; 4,3 m	wood remains from sand layer	>40.000
S95-26	LAO 26-95; 6,5 m above Kokora Lake	tree remain	30.-40.000 oder <10.000
S95-27	LAO 26-95; 6,5 m above Kokora Lake	peat	30.-40.000 oder <10.000
S95-28	LAO 26-95; 6,5 m above Kokora Lake	tree remain	30.-40.000 oder <10.000
S95-29	LAO 30-95; 0,5 m above Tolton River	wood remains	30.-40.000
S95-30	LAO 30-95; 0,5 m above Tolton River	weakly decomposed peat	30.-40.000
S95-31	LAO 31-95; 1,5 m	wood remains	30.-40.000
S95-32	LAO 29; etwa 16 m above Labaz Lake level	tree remain from peat over dead ice	<10.000
S95-33	LAO 33; 3 m above Zaliv Guba	wood remains	30.-40.000 oder <10.000

11.1-4: Main site characteristics of Soil Sites of Severnaya Zemlya Islands: Soil samples

* site 1a
Bolschevik Island / Prima Station: N79°16'44",E101°37'24"
date: August 9,1995
site 1a location: N79°16'38', E101°40'32"
hydrologie: very wet, lake depression
parent material: alluvial deposit, silty-loamy sediment
patterned ground: on steep slopes: nonsorted stripes with sureface layer of gravels, (very flat slopes with sorted nets)
permafrost boundary: 35 cm depth
vegetation: Carex arctisiberica, degree of coverage: + (<5%)
profil:0-2,5cm Ah, 2,5-10cm lCw1, 10-35cm Cw2, >35cm lCf
soil: Pergelic Cryaquept

* site 1b (Bl1/Bölter)
Bolschevik Island
date: August 9,1995
location: N79°16'40", E101°40'34"
hydrologie: wet, slope near lake
parent material: alluvial deposit, fine silty-loamy-skeletal sediment, silt stones
patterned ground: week sorted nets, mudboils, (nonsorted nets)
permafrost boundary: 48 cm depth
vegetation: mooses, lichens
profil: 0-10 cm A, 10-48 Cg, >48cm Cf
soil: Pergelic Cryaquept

* site 1c (Bl5/Bölter)
Bolschevik Island
date: August 9,1995
location: N79°16'44", E101°40'34"
hydrologie: upper slope near see shore
parent material: moraine debris, fine sand/silt stones,
texture: silty sand with up to 75% medium gravels
patterned ground: sorted circles (stone circles)
permafrost boundary: 45 cm depth
vegetation: mosses, lichens
profile: 0-8cm Ah, 8-15cm BwCw, 15-45Cw, >45cm Cf
soil: Lithic Cryorthent

* site 2 (OR1/Bölter)
October Revolution Island, point "first landing "
date: August 10,1995
location: N80°05'59", E95°45'23"
hydrologie: wet, slope near lake
parent material: alluvial of red sandstone, fine sandy-silt
patterned ground: weak nonsorted nets, spots of vegetation
permafrost boundary: 38 cm depth
vegetation:Deschampsia breviflora, Papaver polare,mosses,lichens
profil: 0-2cm Ai (0-4 Ah), 2-38 Cw. >38cm Cf
soil: Pergelic Cryaquept

* site 3 (=Kl1/Bölter, Lok1/Hubberten)
Komsomolsk Island/Edge of Academik Nauk Glacier/Tpyoa River
date: August 10,1995
location: N80°50'11", E96°18'55"
hydrologie: relativ dry
parent material: out wash of sands (mS) with <2% fine-coarse gravels
patterned ground: deflation pavement of coarse gravels (2-6 cm) and stones (6-20 cm) on soil surface (+honey coloured chalcedon)
permafrost boundary: 35 cm depth
vegetation: none (single mosses), polar desert
profile: 0-2 Cw1, 2-35 Cw2, >35cm Cf
soil: Pergelic Cryopsamment

* site 4 (Kl4/Bölter, Lok2/Hubberten)
Komsomolsk Ostrov, south of Academik Nauk Glacier, near Geografic Lake
Date: August 10,1995
location: N 80°10'48", E 94°07'05"
hydrologie: wet, slope near lake
parent material: silt stone, silty-clayey texture
patterned ground: sorted "spots" (circles), center ranges 0,3 to 1,5 m
permafrost boundary: 35cm depth and 47cm depth
vegetation: Saxifraga caespitosa, mosses, lichens
profil:
4a, fine center:0-2cm OAh, 2-10cm Ah, 10-35cm AC, >35cm Cf
4b, coarse border: 0-1 Ai, 1-47 C, <47cm Cf
soil:4a: Fine-silty Pergelic Cryorthent
4b: Fragmental Pergelic Cryorthent/ Lithic Cryorthent

* site 5 and 6
Sredney Islands/ Date: August 10,1995
site 5: Gas filling station/ location: N79°31'13", E91°09'01"
site 6: Meteorological station: location : -none-
Landscape: polar desert with a lot of waste
Soil description: -none-

* site 7.1 and 7.2
October Revolution Island
site 7.1 (OR2/Bölter, Lok3/Hubberten): " Fjordonje Lake" (freshwater lake), Dimas research site; sea-gull colony of Rissa tridactyla; Fossiles: ammonite, bryozoan reef
Date: August 10,1995
location: N79°22'45", E97°44'22"
hydrologie: slope water
parent material: red sandstone, fine loamy-clayey texture
patterned ground: flat slope: nonsorted nets, diameter 3-5m;
steep slope: week nonsorted stripes, stripes 1-2m
permafrost boundary: nets center: 18cm, nets border: 35 cm
vegetation: nets center: mooses dominate with Papaver polare, Saxifraga , nets borders: dominate lichens
profile: 7a: 0-2cm Ai,1-18cm AC, >18cm Cf
7b: 0-4cm O, 4-7cm Ah, 7-35cm C, >35cm Cf
soil: loamy-skelatal to fragmental Pergelic Cryortent
Further soil investigations planned for 1996/97

site 7.2 (Lok4/Hubberten):
Karpinskovogh, edge of glacier, erosion features, glacier gate, water fall
Date: August 11,1995
location: N79°36'30", E97°11'18"
hydrologie: slope water
parent material: moraine of light and dark lime stone,+dolomite
patterned ground: week storted polygones and stripes
permafrost boundary: ?
vegetation: very low coverage(+) of Papaver polare, Deschampsia brevifolia, Saxifraga oppositifolia
soil description/ sampling: none
1996/97 further soil investigations are planned

* site 8 (OR4/Bölter, Lok5/Hubberten)
October Revolution Island, Vavilova glacier, flat upland area
date: August 11,1995
8b Location: N79°32'14",E95°44'16"
hydrologie: wet
parent material: alluvial sands of red sandstone, fine loamy-clayey texture
patterned ground: sorted polygons, diameter of polygones 6-10m
permafrost boundary: ?, > 55 cm
vegetation: polar desert (spots with mooses, Papaver spec.),
two years the glacier ice covered the area -> pionier site for plant and soil developement
profile: 0-2 O/Ai, 2-27 Cw1, >27 Cw2
soil: Fragmental Pergelic Cryortent
no soil sampling!
Further soil investigations planned 1996/97

* site 9 (OR5/Bölter, Lok6/Hubberten)
October Revolution Island, Izmentchivoe Lake(= changeable Red Lake), Dimas special site for propoased sediment sampling 1996/97
date: August 11, 1995
location: N79°06'10", E95°12'04"
hydrologie: wet, slope near lake
parent material: debris of red sandstone, >75% coarse gravels(fG3) with fine earth texture: loamy sand
patterned ground: steep slope: sorted stripes, flat slope: nonsorted nets
permafrost boundary: 25 cm depth
vegetation (3% coverage): mosses, lichens, Saxifraga oppositifolia
profile: sorted stripes: 0-1cm Ai, 1-18 ACg1, 18-25 Cg2, >25cm Cf
soil: Fragmental Pergelic Cryaquept

* site 10 (Lok7/Hubberten)
Bolshivik Island, Lake Trovdoja(max. 7m depth), drinking water for Prima Station, fish: Arctic Shar
date: August 12, 1995
location: N79°15'13", E101°49'16"
hydrologie: very wet, slope near lake
parent material: alluvial sands/gravels with a fine-earth texture of clayey silt
patterned ground: nonsorted circles

permafrost boundary: 47 cm depth
vegetation: mosses, lichens, Papaver polare, Carex arctisiberia
profile 10a: 0-1cm Ai, 1-22 AC, 22-38 C1, 38-47 C2, >47cm Cf
profile 10b: 0-4cm Ah, 4-20 AC
soil: Clayey-skeletal, mixed, nonacid, Pergelic Cryaquept

* site 11 (Lok 8/Hubberten)
Bolshivik Island, Ostantsovaya Canyon,
sea gull colony of "Elfenbeinmöwe" and Rissa tridactyla
date: August 12, 1995
location: N79°02'59", E101°01'42"
hydrologie: dry
parent material: clay schist and sand stone (Aleorithe ?),
schist rock is deeper weathered
patterned ground: sorted circles (borders with sandstone, center with silt/clay schist)
permafrost boundary: ?
vegetation: serval lichens, a special orange-red lichen only on the sandstone and excrements of the sea gulls
profile: 0-4cm Ah(O) - 4-17 (A)Cw
soil: Pergelic Cryorthent

* site 12a and 12b (BI 6/Bölter, Lok9/Hubberten)
Bolschevik Island, N lope of Mosqueta Glacier, since 1980 glacier transgress
date: August 12, 1995
site 12a: border of glacier
location: N 79°10'02", E 102°09'34"
hydrologie: dry
parent material: detris of coarse sandstone and fine clay schist
patterned ground: sorted circles (borders with sandstone, centers with clay schist)
permafrost boundary: ?, > 85 cm depth
vegetation: lichens, mosses (Polytrichum spec.)
profile: 0-2cm Ai, 2-30 Cw1, 30-85 Cw2, >85cm Cf
soil: Fragmental, mixed, nonacid Pergelic Cryorthent

site 12b:
out wash area in front of glacier
location: N79°08', E102° ?
hydrology: dry
parent material: out wash of boulders and gravels of sandstone and clay schist
patterned ground: large sorted polygons (borders with coarse sandstone, center with silt/clay schist, diameter of polygons 8-10m), center of polygons are divided in smaller nonsorted circles (diameter 0,3-0,8m)
permafrost boundary: ? , > 20 cm depth
vegetation: lichens, mosses (coverage > 50%)
profile: 0-5cm Ah, 5-20 ACw, >20 Cw
soil: Fragmental, mixed, nonacid Pergelic Cryorthent

11.1-5: Plant and soil samples for biomarker analysis collected on Severnaya Zemlya during the expedition Taymyr/Zevernaya Zemlya 1995

Bolshevik Island

1b	Lake near Prima Station 79°16'40"N101°40'34"E	08-09-95	Pergelic Cryaquept	hand AARI
1c	Coast near Prima Station 79°16'44" N101°40'34"E	08-09-95	Lithic Cryorthent	hand AARI
10	Lake Tjordoje 79°15'13"N101°49'16" E	08-12-95	Pergelic Cryaquept	hand AARI
11	Canyon Ostantsovaya 79°12'21" N102°01'42"E	08-12-95	Pergelic Cryorthent	hand AARI
12a	Glacier Mosquety 79°10'35" N 102°09'07" E	08-12-95	Pergelic Cryorthent	hand AARI

October Revolution Island

2	North coast 80°05'56" N 95°45'52' E	08-10-95	Pergelic Cryaquept	hand AARI
7.1	Lake Fjordomoje 79°22'44" N 97°44'10" E	08-10-95	Pergleic Cryorthent	hand AARI
9	Lake Izmentchivoe 79°06'10" N95°12'04"E	08-11-95	Pergelic Cryaquept	hand AARI

Komsomolsk Island

3	Tube Valley 80°50'11" N 96°18'53" E	08--10-95	Pergelic Cryopsamment	hand AARI
4	Lake 80°10'13" N 94°07'05" E	08-10-95	Lithic	hand AARI

Table 11.1-6: Description of microbiologically analyzed samples Taymyr/Severnaya Zemlya 1995

Sample	Depth	Remark	Munsell-colour	% H2O	% LOI
LL1.1	0-2	sand	10YR2/1	61,33	54,43
LL1.2	2-5	sand	2.5Y2/0	30,65	8,64
LL1.3	5-10	sand	2.5Y2/0	23,75	5,79
LL2.1	0-2	sand	7.5YR2/0	40,23	22,06
LL2.2	5-10	sand	5YR2.5/1	30,86	12,60
LL2.3	12-16	sand	10YR2/1	20,93	8,06
LL3.1	0-2	sand	5Y2.5/1	28,32	7,28
LL3.2	5-10	sand	5Y2.5/1	28,05	6,80
LL4.1	0-2	cushion	10YR2/1	62,92	69,31
LL4.2	3-8	sand	5Y2.5/1	46,14	20,72
LL5.1	0-2	sand	5Y3/1	13,46	3,25
LL5.2	3-8	sand	5Y3/1	13,39	2,90
BI1.1	0-2	sand	2.5Y4/3	25,11	5,36
BI2.1	0-2	sand	2.5Y5/3	12,15	5,79
BI2.2	2-4	sand	2.5Y4/3	14,38	4,93
BI3.1	0-1	cushion	7.5YR2/0	54,29	30,26
BI3.2	1-3	sand	2.5Y4/4	30,02	7,86
BI4.1	2-5	plant	10YR2/2	55,48	91,17
BI5.1	0-1	cushion	7.5YR2/0	37,95	50,07
BI5.2	1-3	sand	5Y3/1	12,16	8,64
BI6.1	0-2	sand	5Y4/2	9,63	6,66
BI6.2	2-4	sand	5Y4/2	9,29	7,25
OR1.1	0-2	sand	7.5YR4/4	17,74	6,94
OR2.1	0-2	cushion	7.5YR3/3	47,98	24,66
OR2.2	2-4	sand	7.5YR3/4	25,62	8,18
OR3.1	0-1	sand	7.5YR4/3	14,87	6,44
OR3.2	1-3	sand	7.5YR4/2	12,88	6,02
OR4.1	0-1	cushion	5YR3/4	22,49	7,40
OR4.2	1-4	sand	5YR3/4	13,79	6,32
OR5.1	0-2	sand	5YR3/3	46,89	13,13
OR5.2	0-5	sand	5YR3/2	3,45	5,59
KI1.1	0-1	sand	2.5Y5/3	9,21	3,86
KI1.2	2-5	sand	2.5Y5/4	6,76	3,50
KI1.3	5-10	sand	2.5Y5/4	8,76	3,35
KI2.1	0-2	sand	2.5Y4/3	18,90	3,31
KI3.1	0-2	sand	2.5Y5/2	14,73	4,87
KI4.1	0-2	sand	2.5Y2/0	38,44	14,44
KI4.2	2-5	sand	7.5YR3/4	20,98	6,98

LL: Levinson-Lessing Lake
BI: Bolshevik Island
OR: October Revolution Island
KI: Komsomolsk Island

H2O: Water content (% of w.wt.)
LOI: Loss on ignition (% of d.wt.)
all data related to sand <2mm

11.1-7: List of water water samples collected in the Levinson Lessing Lake basin

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
1	05.06.1995 0:00	Snow/1A	3.8	5.65	x	x				
2	05.06.1995 0:00	Snow/2A	17.7	7.16	x	x				
3	05.06.1995 0:00	Snow/2C	15.5	7.31	x	x				
4	05.06.1995 0:00	Snow/3A	5.8	5.58	x	x				x
5	05.06.1995 0:00	Snow/1X	6.5	5.51	x					
6	05.06.1995 0:00	Snow/3D/E	5.5	6.32	x	x				x
7	07.06.1995 0:00	Snow/2X	18.3	6.67	x	x				
8	10.06.1995 0:00	Rain/ Hellmann			x					
9	05.06.1995 0:00	Basal ice layer/2C			x					
10	05.06.1995 0:00	Snow/2b	37.3(?)	7.79	x					
11	10.06.1995 0:00	Permafrost core/3 39-46cm			x					
12	10.06.1995 0:00	Permafrost core/3 46-53cm			x					
13	12.06.1995 0:00	1B/overland flow	138.2	8.12	x	x				x
14	12.06.1995 0:00	1C-soil water from hole14cm	167.7	7.52	x					x
15	12.06.1995 0:00	2A-soil water from hole20cm	224	8.33	x	x				x
16	12.06.1995 0:00	2C-soil water from hole15cm	287	8.37	x	x				x
17	13.06.1995 22:00	Rain	17.3	5.70	x	x				x
18	15.06.1995 18:00	Stream/Slope 1	73.5	8.15	x					x
19	11.06.1995 0:00	Tundra stream into Krasnaja			x					
20	11.06.1995 0:00	Krasnaja			x					
21	11.06.1995 0:00	Krasnaja Sulz			x					
22	14.06.1995 0:00	Protochny	12.5		x					
23	14./15.06.1995	Rain	4.4	5.10		x				
24	15./16.06.1995	Rain	6.1	4.98						
25	15.06.1995 17:30	2C - S3	346	8.18	x					
26	15.06.1995 20:00	2C - S3			x					
27	15.06.1995 14:00	Krasnaja 15m/20cm			x					
28	16.06.1995 14:00	Krasnaja 20m/25cm			x					
29	16.06.1995 14:00	Krasnaja 20m/45cm			x					
30	17.06.1995 0:00	1B W1	184	7.87	x	x				x
31	17.06.1995 0:00	1C W1	219	7.31	x	x				x
32	17.06.1995 0:00	2X W1	229	8.31	x	x				x
33	17.06.1995 0:00	2B W1	277	8.20	x	x				x
34	17.06.1995 0:00	2C W1	329	8.19	x	x				x
35	17.06.1995 0:00	2C S3			x					
36	17.06.1995 19:30	2B S3			x					
37	18.06.1995 12:00	Rain	43.8	4.13	x					
38	17.06.1995 13:00	Krasnaja			x					
39	18.06.1995 13:00	Krasnaja			x					
40	17.06.1995 13:00	2C P2			x					
41	20.06.1995 10:00	Rain	12.4	4.42	x					x
42	20.06.1995 17:00	1C S3	233	7.45	x					x
43	20.06.1995 17:00	2C S3	337	8.10	x	x	x			x
44	20.06.1995 17:00	2B S3			x					
45	20.06.1995 17:00	2X S5	485	8.17	x					
46	21.06.1995 12:00	3A-	20	6.74	x	x				
47	21.06.1995 12:00	3C-standing water	68	7.22	x	x				
48	21.06.1995 12:00	3D/E	64	7.63	x					
49	21.06.1995 12:00	3G/F	62	7.79	x					
50	21.06.1995 15:00	2C S3			x					
51	21.06.1995 16:00	2B S3			x					
52	21.06.1995 17:00	1C S3	228	7.44	x	x				
53	21.06.1995 19:00	2X S5	485	7.99	x	x				x
54	21.06.1995 18:00	1XW	79	7.72	x	x				
55	21.06.1995 18:00	Stream/Slope1	91	7.93	x					

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
56	23.06.1995 0:10	Krasnaja	30.4	7.40	x					
57	23.06.1995 0:10	Krasnaja	30.4	7.40		x				
58	23.06.1995 20:00	Rain/Snow 21.-22.6.	20	4.43	x					
59	23.06.1995 11:00	2C S2	367	8.06	x	x				x
60	24.06.1995 13:00	2B S3				x				
61	24.06.1995 14:00	2C S2	364	8.08	x					
62	24.06.1995 14:00	2C S3	341	7.95	x	x				
63	24.06.1995 14:00	2X S5			x					
64	24.06.1995 14:00	1B S3			x					
65	24.06.1995 14:00	1C S2			x					
66	24.06.1995 14:00	1C S3	238	8.09	x					
67	26.06.1995 16:00	2C S2	370	8.41	x	x				
68	26.06.1995 16:00	2C S3	350	8.53	x					
69	26.06.1995 16:00	1B S3	210	8.18	x					
70	26.06.1995 16:00	1X S3			x					
71	26.06.1995 16:00	1B W2			x					
72	26.06.1995 16:00	1C W2	227	7.67	x	x				x
73	26.06.1995 16:00	1C P2	201	7.44	x					
74	18.06.1995 0:00	Slope 3 0-5	251	7.55	x	x				x
75	18.06.1995 0:00	Slope 3 5-12			x					
76	18.06.1995 0:00	Slope 3 12-17			x					
77	18.06.1995 0:00	Slope 2 0-9			x					
78	28.06.1995 0:00	Slope 3 3A W1	74.3	6.56	x	x				
79	28.06.1995 0:00	Slope 3 3X W	64.8	7.20	x	x				
80	28.06.1995 0:00	Slope 3 3J W	68.3	6.66	x	x				
81	26.06.1995 22:20	Krasnaja			x					
82	27.06.1995 13:00	Krasnaja			x					
83	27.06.1995 21:15	Krasnaja			x					
84	28.06.1995 12:20	Krasnaja			x					
85	29.06.1995 15:30	Krasnaja			x					
86	28.06.1995 0:00	Protochny	52	7.26	x					
87	01.07.1995 0:15	Krasnaja			x					
88	30.06.1995 22:00	2C S2	380	8.43	x	x				
89	30.06.1995 22:00	2C S3			x					x
90	30.06.1995 22:00	2X S5			x					
91	30.06.1995 22:00	1B S3	223	8.02	xx	x				
92	30.06.1995 22:00	1X S3	184	8.13	xx	x				
93	30.06.1995 22:00	1A S3			x					
94	30.06.1995 22:00	2DW	189	8.00	x					
95	30.06.1995 22:00	Stream/Slope 1	96.5	8.27	x					
96	01.07.1995 13:15	Krasnaja			x					
97	01.07.1995 20:15	Krasnaja			x					
98	01.07.1995 14-18:00	2D S3	566	7.61	xx	x				
99	01.07.1995 14-18:00	2C S2	394	8.53	xx	x				
100	01.07.1995 14-18:00	2A S2			x					
101	01.07.1995 14-18:00	2X S5	527	8.52	x	x				
102	01.07.1995 14-18:00	1C S2	262	7.99	xx	x				
103	01.07.1995 14-18:00	1C S3			x					
104	01.07.1995 14-18:00	1B S3	220	8.40	x					
105	01.07.1995 14-18:00	1X S2	207	8.28	x	x				
106	01.07.1995 14-18:00	1X S3	208	8.21	x	x				
107	30.06.1995 22:00	2X S4	582	8.60	x	x				
108	01.07.1995 14-18:00	2X S4	599	8.31	x					
109	30.06.-01.07.1995	Rain	8.3	4.94	xx					
110	02.07.1995 2:30	Krasnaja								
111	01.07.1995 22:00	3A S2	71.5	6.76	xx	x				

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
112	01.07.1995 19-21:00	2D S3	579	8.18	x					
113	01.07.1995 19-21:00	2C S1			x					
114	01.07.1995 19-21:00	2C S2			x					
115	01.07.1995 19-21:00	2C S3			x					
116	01.07.1995 19-21:00	2B S2			x					
117	01.07.1995 19-21:00	2B S3			x					
118	01.07.1995 19-21:00	2X S4			x					
119	01.07.1995 19-21:00	2X S5			x					
120	01.07.1995 19-21:00	2A S2			x					
121	01.07.1995 19-21:00	1X S2			x					
122	01.07.1995 19-21:00	1X S3			x					
123	01.07.1995 19-21:00	1A S2	271	8.15	x					
124	01.07.1995 19-21:00	1A S3	232	8.21	x					
125	01.07.1995 19-21:00	Steam/Slope 1	76.8	8.50						
126	02.07.1995 3:00	2D S3	578	7.92	x					
127	02.07.1995 3:00	2X S4	578	8.19	x					
128	02.07.1995 3:00	2X S5	511	9.09	x					
129	02.07.1995 3:00	2C S3	337	8.26	x					
130	02.07.1995 3:00	2C S2	389	8.17	x					
131	02.07.1995 3:00	2C S1			x					
132	02.07.1995 3:00	2B S1			x					
133	02.07.1995 3:00	2A S2			x					
134	02.07.1995 3:00	1C S2	272	7.38	x	x				
135	02.07.1995 3:00	1C S3	235	7.64	x					
136	02.07.1995 3:00	1B S3	173	7.91	x					
137	02.07.1995 3:00	1B S2	224	7.69	x					
138	02.07.1995 3:00	1X S3	176	7.30	x					
139	02.07.1995 3:00	1X S2			x					
140	02.07.1995 3:00	1A S3			x					
141	03.07.1995 1:15	Krasnaja			x					
142	02.07.1995 22:00	2D S3	585	7.75	x		x			
143	02.07.1995 22:00	2C S3	467	8.22	x		x			
144	02.07.1995 22:00	2X S4	591	8.06	x		x			
145	02.07.1995 22:00	2X S5	501	8.16	x		x			
146	02.07.1995 22:00	2B S3			x					
147	02.07.1995 22:00	2B S2			x					
148	02.07.1995 22:00	2A S2	300	8.28	x					
149	02.07.1995 22:00	1C S2	268	7.46	xx	x				
150	02.07.1995 22:00	1C S3	234	7.37	x					
151	02.07.1995 22:00	1B S3	270	7.71	x					
152	02.07.1995 22:00	1B S2	219	7.73	x					
153	02.07.1995 22:00	1X S3	170	7.88	x	x				
154	02.07.1995 22:00	1X S2	202	9.96	x					
155	02.07.1995 22:00	1A S3	111	8.12	x					
156	05.07.1995 0:00	1B S3	201	7.56	x					
157	05.07.1995 0:00	1B S2			x					
158	05.07.1995 0:00	1C S3	241	7.34	x					
159	05.07.1995 0:00	1C S2	273	7.34	x					
160	05.07.1995 0:00	1X S2	202	8.00	x					
161	05.07.1995 0:00	1X S3	203	7.92	x	x				
162	05.07.1995 0:00	2A S2	293	8.23	x					
163	05.07.1995 0:00	2B S2			x					
164	05.07.1995 0:00	2C S3			x					
165	05.07.1995 0:00	2C S2	388	8.01	x					
166	05.07.1995 0:00	2D S3	623	7.78	x	x				
167	05.07.1995 0:00	2X S4	618	8.10	x					

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
168	05.07.1995 0:00	2X S5	512	8.13	X					
169	05.07.1995 0:00	3A S2			x					
170	29.06.1995 0:00	22-25 cm			x					
171	29.06.1995 0:00	25-29 cm			x					
172	29.06.1995 0:00	295-34			x					
173	29.06.1995 0:00	34-39			x					
174	29.06.1995 0:00	39-43.5			x					
174	29.06.1995 0:00	43.5-47 cm			x					
175	07.07.1995 0:00	Stream/ Slope 1	105.7	8.33	x					
176	09.07.1995 22:00	Stream/Slope 1			x					
177	09.07.1995 0:00	1B S1	103	7.63	x					
178	09.07.1995 0:00	1B S3			x					
179	09.07.1995 0:00	1B S2			x					
180	09.07.1995 0:00	1X S2			x					
181	09.07.1995 0:00	1X S3			x					
182	09.07.1995 0:00	1C S2			x					
183	09.07.1995 0:00	1C S3			x					
184	09.07.1995 0:00	2A S1			x					
185	09.07.1995 0:00	2A S2			x					
186	09.07.1995 0:00	2B S2			x					
187	09.07.1995 0:00	2C S2	404	8.33	x					
188	09.07.1995 0:00	2DS3	649	7.81	x					
189	09.07.1995 0:00	2D S2	553	8.12	x					
190	09.07.1995 0:00	2X S4	698	8.22	x					
191	09.07.1995 0:00	2X S5	545	8.26	x					
192	05.07.1995 0:30	Krasnaja			x					
193	06.07.1995 13:30	Krasnaja			x					
194	11.07.1995 22:00	3A S2			x					
195	11.07.1995 22:00	3D S2	153	6.70	x	x	x			
196	11.07.1995 16:30	Krasnaja								
197	12.07.1995 20:30	1A W2	176.1	7.88	x					x
198	12.07.1995 20:30	1A S2			x					
199	12.07.1995 20:30	1B P1	234	7.29						
200	12.07.1995 20:30	1B P2	196	7.54						
201	12.07.1995 20:30	1B W2	224	7.25	x					x
202	12.07.1995 20:30	1B S1	238	7.73	x					
203	12.07.1995 20:30	1B S3			x					
204	12.07.1995 20:30	1X S3	214	7.88	x					
205	12.07.1995 20:30	1X S2			x					
206	12.07.1995 20:30	1X S1			x					
207	12.07.1995 20:30	1X W	214	7.55						
208	12.07.1995 20:30	1X P1	243	7.54						
209	12.07.1995 20:30	1X P2	219	7.55						
210	12.07.1995 20:30	1C P1	286	6.88						
211	12.07.1995 20:30	1C P2	220	7.04						
212	12.07.1995 20:30	1C W2	345	6.93	x					
213	12.07.1995 20:30	1C S1			x					
214	12.07.1995 20:30	1C S2	284	7.48	x					x
215	12.07.1995 20:30	1C S3			x					
216	12.07.1995 20:30	2A S2			x					
217	12.07.1995 20:30	2A S3			x					
218	12.07.1995 20:30	2A W	287	7.94	x					
219	12.07.1995 20:30	2A overland flow	327	8.19	x					
220	12.07.1995 20:30	2A from hole	285	7.77	x					
221	12.07.1995 20:30	2B S1			x					
222	12.07.1995 20:30	2B S2			x					

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
223	12.07.1995 20:30	2C S2	404	8.24	x					x
224	12.07.1995 20:30	2D S3	652	7.80	x					x
225	12.07.1995 20:30	2D S2	600	7.63	x					x
226	12.07.1995 20:30	2X S5	568	7.98	x					
227	12.07.1995 20:30	2X S2			x					
228	13.07.1995 11:10	Krasnaja (D#159)			x					
229	13.07.1995 11:10	Slope 2 80.5-82			x					
230	13.07.1995 11:10	77-80.5 Slope 2			x					
231	13.07.1995 11:10	75-77 Slope 2			x					
232	13.07.1995 24:00	3F S1			x					
233	13.07.1995 24:00	3D S2			x					
234	13.07.1995 24:00	3D 31			x					
235	13.07.1995 24:00	3C S1			x					
236	13.07.1995 24:00	3B S1			x					x
237	13.07.1995 24:00	3A S1			x					
238	13.07.1995 24:00	3A S2			x					
239	13.07.1995 24:00	3A W			x					x
240	15-16.07.1995	Rain			x					
241	17-18.07.1995	Rain			x					
242	19.07.1995	Rain								
243	19-20.07.1995	Rain								
244	16.07.1995 07:45	Krasnaja			x					
245	16.07.1995 13:00	Krasnaja			x					
246	16.07.1995 19:00	Krasnaja			x					
247	17.07.1995 13:50	Krasnaja			x					
248	17.07.1995 18:50	Krasnaja			x					
249	17.07.1995 23:45	Krasnaja			x					
250	18.07.1995 12:10	Krasnaja			x					
251	21.07.1995 11:00	3AS1	140	6.78	x	x				x
252	21.07.1995 11:00	3AS2	74.9	6.73	x	x				x
253	21.07.1997 11:00	3AW	132	6.43	x	x				
254	21.07.1995 11:00	3AP1			x					
255	21.07.1995 11:00	3AP2	114	6.50	x					
256	21.07.1995 11:10	3BS1	178	6.32	x	x				
257	21.07.1995 11:10	3BS2			x					
258	21.07.1995 11:10	3BP1	118	6.55	x					
259	21.07.1995 11:10	3BP2			x					
260	21.07.1995 11:20	3CS1	148	6.56	x	x				
261	21.07.1995 11:20	3CS2	94	6.70	x	x				
262	21.07.1995 11:20	3CP1			x					
263	21.07.1995 11:20	3CW	81	6.87	x					
264	21.07.1995 11:30	3DS1	147	7.01	x	x				
265	21.07.1995 11:30	3DS2	164	6.70	x	x				
266	21.07.1995 11:30	3DW	112	6.70	x	x				
267	21.07.1995 11:30	3DP1	106	6.68	x	x				
268	21.07.1995 11:40	3EW			x					
269	21.07.1995 11:40	3EP1	81	6.44	x					
270	21.07.1995 11:50	3XS2	200	6.79	x	x				
271	21.07.1995 11:50	3XW	90	6.33	x	x				
272	21.07.1995 12:00	3FS1	128	6.75	x	x				
273	21.07.1995 12:00	3FW			x					
274	21.07.1995 15:00	2DS1	495	7.87	x	x				
275	21.07.1995 15:00	2DS2	656	7.60	x					
276	21.07.1995 15:00	2DS3	673	7.50	x	x				
277	21.07.1995 15:00	2DP1	576	7.44	x	x				
278	21.07.1995 15:00	2DP2	659	7.40	x	x				

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
279	21.07.1995 15:00	2DW	433	7.67	x	x				
280	21.07.1995 15:10	2CS2	420	8.14	x	x				
281	21.07.1995 15:10	2CS3			x					
282	21.07.1995 15:10	2CW	536	7.73	x	x				
283	21. 07.1995 15:10	2CP1			x					
284	21.07.1995 15:20	2XS1	1106	7.60	x	x				
285	21.07.1995 15:20	2XS2	864	7.65	x	x				
286	21.07.1995 15:20	2XS3	827	7.67	x	x				
287	21.07.1995 15:20	2XS4	746	7.74	x	x				
288	21.07.1995 15:20	2XS5	567	7.85	x	x				
289	21.07.1995 15:20	2XP1	1822	7.44	x	x				
290	21.07.1995 15:20	2XP2			x					
291	21.07.1995 15:20	2XW	500	7.69	x	x				
292	21.07.1995 15:30	2BS1	450	8.22	x	x				
293	21.07.1995 15:30	2BS2			x					
294	21.07.1995 15:30	2BS3			x					
295	21.07.1995 15:30	2BP1	398	8.02	x					
296	21.07.1995 15:30	2BP2	282	7.89	x	x				
297	21.07.1995 15:30	2BW	190	8.35	x	x				x
298	21.07.1995 15:40	2AS2	292	8.25	x	x				
299	21.07.1995 15:40	2AS3	340	8.15	x	x				
300	21.07.1995 15:40	2AP1	387	8.10	x					
301	21.07.1995 15:40	2AW	268	7.93	x	x				x
302	21.07.1995 16:00	Stream			x					x
303	21.07.1995 16:10	1CS1	297	7.30	x	x				
304	21.07.1995 16:10	1CS2	282	7.22	x	x				
305	21.07.1995 16:10	1CS3	285	7.66	x	x				
306	21.07.1995 16:10	1CW1	411	7.23	x	x				
307	21.07.1995 16:10	1BS1			x					
308	21.07.1995 16:20	1BS2	255	8.10	x					
309	21.07.1995 16:20	1BS3	251	7.74	x	x				
310	21.07.1995 16:20	1BW1	173	7.80	x	x				
311	21.07.1995 16:30	1XS1	270	8.01	x	x				
312	21.07.1995 16:30	1XS2	241	8.51	x	x				
313	21.07.1995 16:30	1XS3	200	8.11	x	x				
314	21.07.1995 16:30	1XW1	183	7.54	x	x				
315	21.07.1995 16:40	1AS1	151	8.14	x	x				
316	21.07.1995 16:50	1AS3	101	8.20	x	x				
317	21.07.1995 16:50	1AW2			x	x				
318	25.07.1995 14:00	2DS1	535	7.80	x					
319	25.07.1995 14:00	2DS2	622	7.70	x					
320	25.07.1995 14:00	2DW	500	7.62	x	x				
321	25.07.1995 14:00	2DP1	541	7.68	x					
322	25.07.1995 14:00	2DP2	711	7.53	x					
323	25.07.1995 14:00	2DS3	681	8.00	x					
324	25.07.1995 14:20	2XS1			x					
325	25.07.1995 14:20	2XS2			x					
326	25.07.1995 14:20	2XS3	676	8.18	x					
327	25.07.1995 14:20	2XS4	698	###	x					
328	25.07.1995 14:20	2XS5			x					
329	25.07.1995 14:20	2XP1	1950	7.52	x					
330	25.07.1995 14:20	2XP2			x					
331	25.07.1995 14:20	2XW	1345	7.49	x	x				
332	25.07.1995 14:40	2CS2	417	8.22	x	x				
333	25.07.1995 14:40	2CP1	483	7.83	x					
334	25.07.1995 14:40	2CP2			x					

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
335	25.07.1995 14:40	2CW	488	7.90	x	x				
336	25.07.1995 15:00	2BS2	346	###	x					
337	25.07.1995 15:00	2BS3			x					
338	25.07.1995 15:00	2BP1			x					
339	25.07.1995 15:00	2BP2			x					
340	25.07.1995 15:00	2BW	378	8.21	x	x				
341	25.07.1995 15:20	2AS3	359	8.01	x	x				
342	25.07.1995 15:20	2AW	283	8.17	x	x				
343	25.07.1995 15:30	Stream	141	8.58	x					
344	25.07.1995 15:40	1CS1	303	8.11	x					
345	25.07.1995 16:00	1CS2	286	7.78	x					
346	25.07.1995 16:00	1CS3	285	7.92	x	x				
347	25.07.1995 16:00	1CW	416	7.35	x					
348	25.07.1995 16:10	1BS1	257	8.20	x					
349	25.07.1995 16:10	1BS2			x					
350	25.07.1995 16:10	1BS3	259	7.99	x					
351	25.07.1995 16:10	1BP1			x					
352	25.07.1995 16:10	1BP2			x					
353	25.07.1995 16:10	1BW1	253	8.08	x					
354	25.07.1995 16:30	1XS1	255	8.42	x					
355	25.07.1995 16:30	1XS2			x					
356	25.07.1995 16:30	1XS3	211	8.52	x					
357	25.07.1995 16:30	1XP1	224	7.95	x					
358	25.07.1995 16:30	1XP2	205	8.00	x					
359	25.07.1995 16:30	1XW1	226	7.90	x	x				
360	25.07.1995 16:40	1AS1			x					
361	25.07.1995 19:00	3AS1			x					
362	25.07.1995 19:00	3AS2			x					
363	25.07.1995 19:00	3AP1			x					
364	25.07.1995 19:00	3AP2			x					
365	25.07.1995 19:00	3AW	206	6.68	x	x				
366	25.07.1995 19:20	3BP1			x					
367	25.07.1995 19:20	3BW	120	6.27	x	x				
368	25.07.1995 19:40	3CS2			x					
369	25.07.1995 19:40	3CW			x					
370	25.07.1995 20:00	3XS2	167	6.74	x	x				
371	25.07.1995 20:00	3XW	118	6.51	x					
372	25.07.1995 20:20	3DS2	126	7.51	x	x				
373	25.07.1995 20:20	3DP1	81.4	7.27	x					
374	25.07.1995 20:20	3DP2	100.1	6.90	x					
375	25.07.1995 20:20	3DW	115	7.00	x	x				
376	25.07.1995 20:40	3ES2	104	6.79	x					
377	27.07.1995 20:40	3EP2			x					
378	25.07.1995 20:40	3EW			x					
379	25.07.1996 21:00	3FS1	128	7.29	x					
380	23.07.1995 13:40	Krasnaja			x					
381	27.07.1995 19:00	Protochny			x					
382	28.07.1995 14:10	Krasnaja			x					
383	28.07.1995 00:30	Lele A 20m			x					
384	28.07.1995 00:30	Lele A 2m			x					
385	28.07.1995 00:30	Lele A 44m			x					
386	19.07.1995 18:30	Krasnaja			x					
387	19.07.1995 00:30	Krasnaja			x					
388	31.07-02.08.1995	Rain			x					
389	01-02.08 1995	Rain			x					
390	20.07.1995 19:20	Krasnaja			x					

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
391	28.01.1995 14:00	Krasnaja			x					
392	29.07.1995 17:00	Krasnaja			x					
393	31.07.1995 19:10	Krasnaja			x					
394	31.07.1995	Holger P43			x					
395	31.07.1995	Holger P43			x					
396	27.07.1995	P2/Slope 3			x					
397	27.07.1995	P2/Slope 3			x					
398	01.08.1995	River1			x					
399	01.08.1995	River2			x					
400	01.08.1995	River3			x					
401	02-03.08.1995	Rain			x					
402	03-04.08.1995	Rain			x					
403	04-05.08.1995	Rain			x					
404	04.08.1995 14:00	D#236			x					
405	06.08.1995 15:00	3AS1			x					
406	06.08.1995 15:00	3AS2			x					
407	06.08.1995 15:00	3AP1			x					
408	06.08.1995 15:00	3AP2			x					
409	06.08.1995 15:00	3AW	190	6.50	x	x				
410	06.08.1995 15:20	3BS1	175	7.03	x					
411	06.08.1995 15:20	3BP1			x					
412	06.08.1995 15:20	3BW	112	6.70	x					
413	06.08.1995 15:40	3CW	122	6.81	x					
414	06.08.1995 15:40	3CP1			x					
415	06.08.1995 15:40	3CS1			x					
416	06.08.1995 15:40	3XP1			x					
417	06.08.1995 15:40	3XW	120	6.33	x	x				
418	06.09.1995 15:40	3XS1	188	6.61	x	x				
419	06.08.1995 15:40	3XS2	173	6.81	x	x				
420	06.08.1995 16:00	3DW	107	7.40	x					
421	06.08.1995 16:00	3DP1			x					
422	06.08.1995 16:00	3DS2	97	7.20	x					
423	06.08.1995 16:10	3EP1			x					
424	06.08.1995 16::10	3EW			x					
425	06.08.1995 16:10	3ES2	97	7.32	x					
426	06.08.1995 16:30	3FS1	153	7.60	x					
427	07.08.1995	2DW	511	7.70	x	x				
428	07.08.1995	2DP1	575	7.92	x					
429	07.08.1995	2DP2	786	7.50	x					
430	07.08.1995	2DS3			x					
431	07.08.1995	2DS2			x					
432	07.08.1995	2CW	506	8.10	x	x				
433	07.08.1995	2CP1			x					
434	07.08.1995	2CP2			x					
435	07.08.1995	2CS2			x					
436	07.08.1995	2XS1	1188	7.87	x					
437	07.08.1995	2XS2			x					
438	07.08.1995	2XS3	694	8.27	x					
439	07.08.1995	2XS4	672	8.21	x					
440	07.08.1995	2XS5	531	8.23	x					
441	07.08.1995	2XP1	1969	7.64	x					
442	07.08.1995	2XP2			x					
443	07.08.1995	2XW	630	8.00	x					
444	07.08.1995	2BW	407	8.37	x	x				
445	07.08.1995	2BS2	438	8.39	x					
446	07.08.1995	2BS1			x					

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
447	07.08.1995	2BP1	456	8.26	x	x				
448	07.08.1995	1CS2			x					
449	07.08.1995	1CS3			x					
450	07.08.1995	1CW1	393	7.21	x	x				
451	07.08.1995	1BW1	209	7.51	x					
452	07.08.1995	1BS1	262	7.74	x	x				
453	07.08.1995	1BS2			x					
454	07.08.1995	1BS3	271	8.28	x					
455	07.08.1995	1XW1	247	7.98	x	x				
456	07.08.1995	1XS1			x					
457	07.08.1995	1XS2			x					
458	07.08.1995	1XS3	220	8.39	x	x				
459	07.08.1995	1XP1			x					
460	07.08.1995	1AS1	234	8.44	x	x				
461	14.08.1995 17:30	2DS2			x					
462	14.08.1995 17:30	2DS3			x					
463	14.08.1995 17:30	2DW	497	7.70	x	x				
464	14.08.1995 17:30	2DP1			x					
465	14.08.1995 17:30	2DP2			x					
466	14.08.1995 18:30	2BS1			x					
467	14.08.1995 18.30	2BS2			x					
468	14.08.1995 18:30	2BW	420	8.50	x					
469	14.08.1995 18:30	2BP1			x					
470	14.08.1995 17:50	2CS2			x					
471	14.08.1995 17:50	2CP1			x					
472	14.08.1995 17:50	2CP2			x					
473	14.08.1995 17:50	2CW	514	8.25	x	x				
474	14.08.1995 18:10	2XS1			x					
475	14.08.1995 18:10	2XS2			x					
476	14.08.1995 18:10	2XS3			x					
477	14.08.1995 18:10	2XS4			x					
478	14.08.1995 18:10	2XS5			x					
479	14.08.1995 18:10	2XP1	2260	7.90	x					
480	14.08.1995 18:10	2XP2			x					
481	14.08.1995 18:10	2XW	1385	7.85	x					
482	14.08.1995 18:50	2AW	376	8.30	x	x				
483	14.08.1995 18:50	2AS2			x					
484	14.08.1995 18:50	2AS1			x					
485	14.08.1995 15:20	Stream	209	8.50	x	x				
486	14.08.1995 19:30	1CS1			x					
487	14.08.1995 19:30	1CS2			x					
488	14.08.1995 19:30	1CW	453	7.24	x	x				
489	14.08.1995 19:50	1BC1			x					
490	14.08.1995 19:50	1BS2			x					
491	14.08.1995 19.50	1BS3			x					
492	14.08.1995 20:10	1XS1			x					
493	14.08.1995 20:10	1XS2			x					
494	14.08.1995 20:10	1XS3			x					
495	14.08.1995 20:10	1XP1			x					
496	14.08.1995 20:10	1XP2			x					
497	14.08.1005 20.10	1XW	272	7.87	x					
498	14.08.1995 20:30	1AS1			x					
499	14.08.1995 23:20	3AS1			x					
500	14.08.1995 23:20	3AS2			x					
501	14.08.1995 23:20	3AP1			x					
502	14.08.1995 23:20	3AP2			x					

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
503	14.08.1995 23:20	3AW	198	6.90	x					
504	14.08.1995 23:40	3BP1			x					
505	14.08.1995 23:40	3BW	126	6.80	x					
506	14.08.1995 23:40	3BS1	191	6.90	x					
507	14.08.1995 00:00	3CS2			x					
508	14.08.1995 00:00	3CP1			x					
509	14.08.1995 00:00	3CW	172	7.40	x					
510	15.08.1995 00:10	3XS1			x					
511	15.08.1995 00:20	3XS2	196	7.00	x					
512	15.08.1995 00:20	3XW	103	6.70	x					
513	15.08.1995 00:40	3DS2	95	7.38	x					
514	15.08.1995 00:40	3DW	121	7.38	x					
515	15.08.1995 01:00	3EW			x					
516	15.08.1995 01:10	3ES2	93	7.57	x					
517	15.08.1995 01:20	3FS1			x					
518	12.08.1995 night	Rain			x					
519	10.08.1995	Lele A 2m			x					
520	10.08.1995	Lele A 20m			x					
521	10.08.1995	Lele A 40m			x					
522	04.08.1995 14:00	Krasnaja			x					
523	07.08.1995 12:00	Krasnaja			x					
524	10.08.1995 19:40	Krasnaja			x					
525	12.08.1995 12:50	Krasnaja			x					
526	12.08.1995 15:00	Krasnaja			x					
527	12.08.1995 19:35	Krasnaja			x					
528	13.08.1995 00:50	Krasnaja			x					
529	15.08.1995 13:00	Krasnaja			x					
530	16.08.1995 12:15	Krasnaja			x					
531	16.08.1995 18:00	Protochny			x					
532	18.08.1995 18:00	Krasnaja			x					
533	19.08.1995 19:30	Krasnaja			x					
534	21.08.1995	Lele A 2m			x					
535	21.08.1995	Lele A 20m			x					
536	21.08.1995	Lele A 40m			x					
537	22.08.1995 16:00	Krasnaja			x					
538	21.08.1995 23:00	3AW			x					
539	21.08.1995 23:00	3AS1			x					
540	21.08.1995 23:10	3BW			x					
541	21.08.1995 23.10	3BS1			x					
542	21.08.1995 23:20	3CW	206	6.78	x					
543	21.08.1995 23:20	3CS2			x					
544	21.08.1995 23:30	3XW	129	6.80	x					
545	21.08.1995 23:30	3XS1	166	6.78	x					
546	21.08.1995 23:30	3XS2	208	6.97	x					
547	21.08.1995 23:40	3DS2	97	7.30	x					
548	21.08.1995 23:45	3EW	84	6.44	x					
549	21.08.1995 23:45	3ES2	91	6.90	x					
550	21.08.1995 23:50	3FS1			x					
551	21.08.1995 17:30	2DW			x					
552	21.08.1995 20:45	2DS2			x					
553	21.08.1995 20:45	2DS3			x					
554	21.08.1995 17:40	2CW			x					
555	21.08.1995 20:55	2CS2			x					
556	21.08.1995 17:50	2XW			x					
557	21.08.1995 21:10	2XS1			x					
558	21.08.1995 21:10	2XS3			x					

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
559	21.08.1995 21:00	2XS4			x					
560	21.08.1995 21:10	2XS5	560	8.53	x					
561	21.08.1995 18:10	2BW	717	7.92	x					
562	21.08.1995 21:20	2BS2			x					
563	21.08.1995 21:20	2BS3			x					
564	21.08.1995 18:30	2AW	374	8.08	x					
565	21.08.1995 21:30	2AS2	364	8.38	x					
566	21.08.1995 21:30	2AS3			x					
567	21.08.1995 19:00	Stream	231	8.25	x					
568	21.08.1995 19:10	1CW1	493	7.35	x					
569	21.08.1995 22:00	1CS1			x					
570	21.08.1995 22:00	1CS2			x					
571	21.08.1995 22:00	1CS3			x					
572	21.08.1995 22:10	1BS3			x					
573	21.08.1995 19:30	1XW			x					
574	21.08.1995 22:20	1XS1			x					
575	21.08.1995 22:20	1XS2			x					
576	21.08.1995 22:20	1XS3			x					
577	21.08.1995 22:30	1AS1	261	8.15	x					
578	23.08.1995 19:30	Krasnaja			x					
579	24-25.08.1995	Rain			x					
580	25.08.1995 12:50	Krasnaja			x					
581	25.08.1995 15:00	Krasnaja			x					
582	25.08.1995 18:50	Krasnaja			x					
583	25.08.1995 21:40	Krasnaja			x					
584	26.08.1995 14:00	Krasnaja			x					
585	28.08.1995 18:00	Protochny			x					
586	28.08.1995 18:00	Lele 2m			x	x				
587	28.08.1995 11:00	Lele 20m			x	x				
588	28.08.1995 16:00	Lele 40m			x	x				
589	29.08.1995 21:00	Krasnaja			x	x				
590	28.08.1995 15:00	Protochny			x	x				
591	31.08.1995	Rain			x					
592	31.08.1995 15:40	Krasnaja	93.8	7.50	x	x				
593	02.08.1995	Rain			x					
594	11.09.1995	1CW1	282	7.50	x				x	
595	11.09.1995	1CW2	404	7.50	x				x	
596	11.09.1995	2DW	591	7.60	x	x		x	x	x
597	11.09.1995	2DP1	547	7.70	x					
598	11.09.1995	2DP2			x					
599	11.09.1995	2CP1			x					
600	11.09.1995	2AW	589	8.10	x	x		x	x	
601	11.09.1995	3AW	208	6.90	x	x			x	
602	11.09.1995	3AP1			x					
603	11.09.1995	3BW	122	7.40	x	x			x	
604	11.09.1995	3BP1			x					
605	11.09.1995	3CW	203	6.90	x	x			x	
606	11.09.1995	3CP1			x					
607	11.09.1995	3DW							x	
608	11.09.1995	3EW	77	6.70	x	x		x	x	x
609	11.09.1995	3GW	149	6.50	x			x	x	x
610	11.09.1995	3XW	86	7.20	x	x		x	x	
611	11.09.1995	Stream1	387	8.20	x					
612	11.09.1995	1AS1	243	8.10	x					
613	11.09.1995	1BS1	217	8.10						
614	11.09.1995	1BS3	201	8.30						

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
615	11.09.1995	2XS1	1540	8.30						
616	11.09.1995	2XS2	1440	8.40	x					
617	11.09.1995	2XS3	993	8.40	x					
618	11.09.1995	2XS5	742	8.50						
619	11.09.1995	3BS1	175	8.00	x					
620	11.09.1995	3CS2	201	8.10						
621	11.09.1995	3XS1	177	7.10	x	x			x	
622	11.09.1995	3XS2	213	7.80	x				x	
623	11.09.1995	3DS1	87	7.40	x	x		x	x	x
624	11.09.1995	3DS2	91	7.80	x	x				
625	11.09.1995	3ES	86	7.40	x	x			x	
626	11.09.1995	3FS	129	7.60	x					
627	12.09.1995	3CS2	198	8.10						
628	12.09.1995	3XS1	178	7.10	x	x			x	
629	12.09.1995	3XS2	223	8.10						
630	12.09.1995	3DS1	95	7.80	x					
631	12.09.1995	3DS2	86	7.40	x					
632	12.09.1995	3ES1	86	7.30	x					
633	12.09.1995	3ES2	87	7.50	x	x				
634	13.09.1995	1CB2	442	7.20	x					
635	13.09.1995	Protochny	57	7.20	x					
636	13.09.1995	2AS3	432	7.90		x				
637	13.09.1995	2AS2	425	7.80						
638	13.09.1995	3ES1	60	7.20	x	x				
639	13.09.1995	3ES2	83	7.40	x					
640	13.09.1995	3DS1	80	7.50	x					
641	13.09.1995	3DS2			x					
642	13.09.1995	3XS2	241	7.50	x					
643	13.09.1995	3XS1	175	7.00	x					
644	13.09.1995	Krasnaja	121	7.40	x					
645	14.09.1995	3AW	203	6.40	x				x	
646	14.09.1995	3BW	135	6.60	x			x	x	x
647	14.09.1995	3BP1	148	6.30						x
648	14.09.1995	3CW	204	7.20	x	x		x	x	
649	14.09.1995	3CP1			x					
650	14.09.1995	3CP2	58	6.80						
651	14.09.1995	3XW	90	6.60	x				x	
652	14.09.1995	3EW	77	6.40	x	x		x	x	
653	14.09.1995	3XP2	154	7.10						
654	14.09.1995	Snow	8	6.10	x	x				x
655	16.09.1995	Lele A 2m	59	7.90	x	x				x
656	16.09.1995	Lele A 20m	59	7.60	x	x				x
657	16.09.1995	Lele A 40m	59	7.50	x	x				x
658	16.09.1995	Lele Lake Diatoms								
659	14.09.1995	Snow 34X	7	6.10	x	x			x	x
660	15.09.1995	Snow 2D	14	6.70	x	x		x	x	x
661	17.09.1995	2DW	534	7.40	x	x		x	x	x
662	17.09.1995	Lele A 2m	56	7.50	x					
663	17.09.1995	Lele A 25m	57	7.50	x					
664	17.09.1995	Lele	57	7.40	x					
665	17.09.1995	Lele	57	7.50	x					
666	17.09.1995	3DS1	86	7.70						
667	17.09.1995	3DS2	120	6.70	x	x		x	x	x
668	17.09.1995	3ES1	58	7.50						
669	17.09.1995	3ES2	93	7.60						
670	17.09.1995	3XS1	180	6.90	x	x			x	x

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
671	17.09.1995	3XS2	225	7.30						
672	18.09.1995	Tundra Stream	584	7.30		x				
673	19.09.1995	Protochny	63	7.60	x					
674	17.09.1995	1C/Soil Frozen	215	7.66	x					
675	20.09.1995	Krasnaja	137	7.60	x					
676	20.09.1995	3ES2	102	7.60	x				x	
677	20.09.1995	3XS1	130	7.20	x				x	
678	20.09.1995	3XS2	155	8.00	x					
679	20.09.1995	3DS2	123	7.60	x				x	
680	20.09.1995	3ES1	36	7.30						
681	20.09.1995	Stream1 Frozen	54	7.40	x					x
682	21.09.1995	Rain/Snow	8	5.80	x					
683	21.09.1995	3ES2	102	7.40	x					
684	21.09.1995	3XS2	132	7.90	x					
685	21.09.1995	3XS1	173	7.90	x					
686	21.09.1995	3DS2	36	7.50	x				x	
687	22.09.1995	Krasnaja	137	7.60	x					
688	23.09.1995	Lele A 2m	59	6.98	x					x
689	23.09.1995	Lele A 20m	58	7.09	x					x
690	23.09.1995	Lele A 40m	58	7.12	x					x
691	23.09.1995	Sediment Trap Point A								
692	23.09.1995	Sediment Trap Point A								
693	23.09.1995	Sediment Trap Point A								
694	25.09.1995	Frozen ground 6-7 cm Slope	119	6.33	x					
695	25.09.1995	Snow	6	5.16	x					x
696	25.09.1995	Lele Lake PointB	56	7.06						
697	25.09.1995	Lele Lake PointB	57	7.42						
698	25.09.1995	Lele Lake PointB	58	7.32						
699	25.09.1995	Lele Lake PointB	57	7.22						
700	25.09.1995	4A	171	6.28	x	x		x	x	x
701	24.09.1995	Frozen Ground Slope3			x					
702	24.09.1995	Frozen Ground Slope3			x					
703	24.09.1995	Frozen Ground Slope3			x					
704	24.09.1995	Frozen Ground Slope3			x					
705	24.09.1995	Frozen Ground Slope3	?	?	x					
706	24.09.1995	Frozen Ground Slope3			x					
707	24.09.1995	Frozen Ground Slope3			x					
708	25.09.1995	3XS1			x					
709	25.09.1995	3XS2			x					
710	25.09.1995	3ES1			x					
711	25.09.1995	3ES2			x					
712	26.09.1995	4AW	114	6.54	x	x			x	
713	26.09.1995	4A Pit	135	6.43	x	x			x	
714	26.09.1995	3EW	70	6.79	x				x	
715	27.09.1995	Krasnaja	151	7.50	x					
716	27.09.1995	4AW	168	6.37	x	x		x	x	x
717	27.09.1995	Stream "Krack"	11	6.50	x					x
718	29.09.1995	Pit4 0-6cm frozen	420	6.90	x	x			x	
719	29.09.1995	Pit4 6-11cm frozen							x	
720	29.09.1995	Pit 4 0-6cm frozen							x	
721	29.09.1995	#4 6-11cm frozen							x	
722	29.09.1995	Protochny	61	7.50	x					
723	29.09.1995	Krasnaja	156	7.50	x					
724	29.09.1995	2D Pit	606	7.80	x	x		x	x	x
725	30.09.1995	Lele 2m	58	7.40						
726	30.09.1995	Lele 20m	57	7.50						

Nr.	Date	Location	LF	pH	O/D	Cation	Anion	PO4	NO3	3-H
727	30.09.1995	Lele 40m	57	7.50						
728	30.09.1995	Diatoms PointA								
729	30.09.1995	4AW	144	6.40	x	x		x	x	
730	30.09.1995	Ice Core at #4 6-9 cm			x					
731	30.09.1995	Ice Core at #4 9-12cm			x					
732	30.09.1995	Ice Core at #4 12-15cm			x					
733	30.09.1995	Ice Core at #4 15-18cm			x					
734	30.09.1995	Ice Core at #4 18-21cm			x					
735	30.09.1995	Ice Core at #4 21-27cm			x					x
736	30.09.1995	Ice Core at #4 27-33cm			x					
737	30.09.1995	Ice Core at #4 33-39cm			x					x
738	30.09.1995	Ice Core at #4 39-41cm			x					x
739	30.09.1995	Ice Core at #4 41-44cm			x					
740	30.09.1995	Ice Core at #4 44-47cm			x					
741	30.09.1995	Ice Core at #4 47-49cm			x					
742	30.09.1995	Ice Core at #4 49-51cm			x					
743	30.09.1995	Ice Core at #4 51-53cm			x					
744	30.09.1995	Ice Core at #4 53-55cm			x					
745	30.09.1995	Ice Core at #4 55-56cm			x					
746	30.09.1995	Sediment Trap PointA #1								
747	30.09.1995	Sediment Trap Point A #2								
748	30.09.1995	Sediment Trap PointA #3								
749	02.10.1995	3ES2	140	7.70	x	x			x	
750	02.10.1995	Protochny	56	7.20	x					
751	03.10.1995	3D/E	26	6.20	x				x	
752	07.10.1995	Krasnaja	165	7.40	x					
753	07.10.1995	Lele 2m	53	7.40	x					x
754	07.10.1995	Lele 20m	56	7.40	x	x				x
755	07.10.1995	Lele 40m	56	7.40	x	x				x
756	07.10.1995	Sediment Trap Point A #1								
757	07.10.1995	Sediment Trap PointA #2								
758	07.10.1995	Sediment Trap PointA #3								
759	09.10.1995	3ES2			x					
760		Core #3 0-2cm			x					
761		Core #3 2-5cm			x					
762		Core #3 15-18cm			x					
763		Core #3 18-20cm			x					
764		Core #3 20-22cm			x					
765	07.10.1995	4AW	129	6.70						
766	10.10.1995	Krasnaja Ice	42	7.79	x					

11.1-8: Sediment samples collected during the expedition Taymyr 1995 (abbreviations see end of table)

core no. station-employ	sediment source	position latitude	longitude	water depth (m)	gear	recovery (cm)	preliminary storage
PG1225 - 1	Lake Kokora	72°26´12“	99°25´41“	18,2	SL	0 - 23	AWI
PG1225 - 2	Lake Kokora	72°26´12“	99°25´41“	18,2	KOL	0 - 250	AARI
PG1225 - 3	Lake Kokora	72°26´12“	99°25´41“	18,2	SL	0 - 11,5	AWI
PG1225 - 4	Lake Kokora	72°26´12“	99°25´41“	18,2	KOL	0 - 248	AWI
PG1225 - 5	Lake Kokora	72°26´12“	99°25´41“	18,2	KOL	227 - 430	AWI
PG1225 - 6	Lake Kokora	72°26´12“	99°25´41“	18,2	KOL	0 - 280	AWI
PG1225 - 7	Lake Kokora	72°26´12“	99°25´41“	18,2	KOL (Ø=3cm)	350 - 515	AWI
PG1226 - 1	Lake Portnyagino	74°11´0,9“	106°52´56,9“	4,01	SR	0 - 15	AWI
PG1226 - 2	Lake Portnyagino	74°11´0,9“	106°52´56,9“	4,01	SR	0 - 22	AWI
PG1226 - 3	Lake Portnyagino	74°11´0,9“	106°52´56,9“	4,01	KOL	0 - 179	AWI
PG1226 - 4	Lake Portnyagino	74°11´0,9“	106°52´56,9“	4,01	KOL	189 - 375	AWI
PG1226 - 5	Lake Portnyagino	74°11´0,9“	106°52´56,9“	4,01	KOL	89 - 278	AWI
PG1226 - 6	Lake Portnyagino	74°11´0,9“	106°52´56,9“	4,01	KOL (Ø=3cm)	325 - 493	AWI
PG1227 - 1	Lake Taymyr	74°32´44,5“	101°42´58,7“	18,41	SL	0 - 24	AWI
PG1227 - 2	Lake Taymyr	74°32´44,5“	101°42´58,7“	18,41	SL	0 - 25	AWI
PG1227 - 3	Lake Taymyr	74°32´44,5“	101°42´58,7“	18,41	SL	0 - 24	AARI
PG1227 - 4	Lake Taymyr	74°32´44,5“	101°42´58,7“	18,41	SL	0 - 22,5	AARI
PG1227 - 5	Lake Taymyr	74°32´44,5“	101°42´58,7“	18,41	SL	0 - 20	AARI
PG1227 - 6	Lake Taymyr	74°32´44,5“	101°42´58,7“	18,41	KOL	0 - 277	AWI
PG1227 - 7	Lake Taymyr	74°32´44,5“	101°42´58,7“	18,41	KOL	215 - 510	AWI
PG1227 - 8	Lake Taymyr	74°32´44,5“	101°42´58,7“	18,41	KOL	465 - 761	AWI
PG1227 - 9	Lake Taymyr	74°32´44,5“	101°42´58,7“	18,41	KOL	715 - 1015	AWI
PG1227 - 10	Lake Taymyr	74°32´44,5“	101°42´58,7“	18,41	KOL	965 - 1263	AWI
PG1227 - 11	Lake Taymyr	74°32´44,5“	101°42´58,7“	18,41	KOL	1215 - 1426	AWI
PG1228 - 1	Levinson-Lessing	74°28´25,4“	98°38´10,5“	108	SL	0 - 18,5	AWI

11.1-8: Sediment samples collected during the expedition Taymyr 1995 (abbreviations see end of table)

core no. station-employ	sediment source	position latitude	longitude	water depth (m)	gear	recovery (cm)	preliminary storage
PG1228 - 2	Levinson-Lessing	74°28´25,4"	98°38´10,5"	108	SL	0 - 27	AWI
PG1228 - 3	Levinson-Lessing	74°28´25,4"	98°38´10,5"	108	KOL	0 - 234	AWI
PG1228 - 4	Levinson-Lessing	74°28´25,4"	98°38´10,5"	108	KOL	190 - 486	AWI
PG1228 - 5	Levinson-Lessing	74°28´25,4"	98°38´10,5"	108	KOL	440 - 744	AWI
PG1228 - 6	Levinson-Lessing	74°28´25,4"	98°38´10,5"	108	KOL	690 - 987	AWI
PG1228 - 7	Levinson-Lessing	74°28´25,4"	98°38´10,5"	108	KOL	940 - 1235	AWI
PG1228 - 8	Levinson-Lessing	74°28´25,4"	98°38´10,5"	108	KOL	1215 - 1482	AWI
PG1228 - 9	Levinson-Lessing	74°28´25,4"	98°38´10,5"	108	KOL	1440 - 1742	AWI
PG1228 - 11	Levinson-Lessing	74°28´25,4"	98°38´10,5"	108	KOL	1690 - 1990	AWI
PG1228 - 13	Levinson-Lessing	74°28´25,4"	98°38´10,5"	108	KOL	1940 - 2230	AWI
PG1229 - 1	Levinson-Lessing	74°25,864'	98°44,533'	22	SL	0 - 16	AWI
PG1230 - 1	Levinson-Lessing	74°26,740'	98°42,701'	86	SL	0 - 13,5	AWI
PG1231 - 1	Levinson-Lessing	74°29,781'	98°35,921'	94	SL	0 - 11,5	AWI
PG1232 - 1	Levinson-Lessing	74°30,410'	98°35,765'	67	SL	0 - 24	AWI
PG1233 - 1	Levinson-Lessing	74°30,371'	98°35,532'	76	SL	0 - 28	AWI
PG1233 - 2	Levinson-Lessing	74°30,371'	98°35,532'	76	SL	0 - 32	AWI
PG1234 - 1	Levinson-Lessing	74°30,427'	98°35,216'	76	SL	0 - 29	AWI
PG1235 - 1	Levinson-Lessing	74°31,804'	98°36,700'	45	SL	0 - 24	AWI
PG1236 - 1	Levinson-Lessing	74°31,197'	98°35,559'	68	SL	0 - 34	AWI

SR = "Stechrohr" (hand pushed corer)
SL = "Schwerelot" (gravity corer)
KOL = "Kolbenlot" (piston corer)

AARI = Arctic and Antarctic Research Institute, St. Petersburg
AWI = Alfred Wegener Institut, Potsdam

11.1-9: Ecological samples

Novaya settlement, Kheta river

Sample No.	Sampling site, Ground character, Sampling conditions
1	Area in Novaya settlement, 200 m from the settlement upstream river, water discharge, temperature of +22 C
2	50 m from the ship mooring, in the area of coal dumping
3	DES, opposite the mooring of the motor-boat, in 200 m from the shore
4	Kresty-settlement, in 300 m from the shore along the DES, there is a road nearby, waste damp
5	The oil base in 800 m from the settlement downstream river
6	The lake in 600 m from the settlement upstream river
7	DES in the outskirts of the settlement
8	Tundra upstream the river in 1.5 km from the settlement
9	Center of the settlement, 200 m from the settlement administration, near the living house, a road

Zhdanikha settlement

10	water edge, place of drinking water intake
11	River mouth in 1.5 km from the settlement, upstream river (mooring place), rocky ground, temperature of +25^{O}C
12	Storage tanks for fuel-lubricants (50 m offshore), liquescent ground due to discharge of water and fuel-lubricants, temperature of +25^{O}C
13	Region of animal farm (30-40 m above river level), well-worn road, temperature of +25^{O}C,
14	DES (in 300 m from the shore inside the settlement, dense ground at the refueling place, a road, temperature of +25^{O}C
15	Water edge in the water intake place, temperature of +25^{O} C, sand, pebble

Khatanga settlement

16	water intake place, temperature of +18^{O} C, sand
17	discharge stream, temperature of +18^{O}C, sand
18	discharge lake at the outskirts of the settlement, tundra, temperature of +19 ^{O}C

Polar station Taymyr Lake

19	"Makeyevka" base, near a house

20	"Makeyevka" base, dumping site
21	Meteorological site
22	Western margin of the station
23	A toilet near baloks
24	A road to the south-west of the station
25	The last house to the south-west
26	A mess-room (central entrance)
27	Storage and refueling place (a 10 cm^3 tank)
28	Water discharge from a bath-house, temperature of +15 ^{o}C, washed out tundra
29	The road along the lagoon, temperature of +14 ^{o}C, compressed ground
30	DES, Storage and oil refueling place
31	A pool near the mess-room.
32	Place of fish water discharge
33	Dumping site in 1 km from the station
34	Eastern margin of the station
35	Galley water discharge place
36	Water edge and water intake place
37	The area with typical vegetation
38	The road, dumping site west of the station, place of storing drums from faecal waste
39	The area in 1-2 km from the station
40	A toilet near the mess-room
41	Place of the diesel fuel spill in June 1994
42	A pool in 30 m east of the mess-room, a road.

11.1-10: List of samples for the determination of natural and artificial radionuclides in soil and biota

No. of Sample	Sampling site	Description
33.	Krasnaya river mouth, 1st river terrace	
34.	North-western angle of the Levinson-Lessing Lake, slope of 10 , vegetation	herbage-shrub
35.	Right bank of Krasnaya river, 6 km from the mouth	herbage-moss-shrub vegetation
36.	Right bank of Krasnaya river, 5 km from the mouth	hummocky marsh tundra
37.	North-western Levinson-Lessing Lake, upper slope part 250 m above sea level	
38.	North-western Levinson-Lessing Lake, southern exposition slope from a 100 m terrace, left water boundary of the stream.	
39.	Moisturized slope of the southern relic,exposition in the northern Levinson-Lessing Lake	hillocky tundra
40.	North-western slope of the Levinson-Lessing Lake, 100-150 m above sea level	rocky tundra
41.	North-western Levinson-Lessing Lake, upper slope part 250 m above sea level	
42.	North-western Levinson-Lessing Lake,100-150 m above sea level.	
43.	North-western Levinson-Lessing Lake, polygonal tundra	
44.	Near-mouth area of Krasnaya river, flooded surface	Cotton-sedge-grass-vegetation
45.	Hillocky slope of the 1st terrace of Krasnaya river, 700 m from the mouth	Moss-herbage-shrub vegetation
46.	North-western Levinson-Lessing Lake, nivation niche of the southern exposition at the eastern tip of a 100 m terrace	Moss-shrub-vegetation
47.	North-western Levinson-Lessing Lake, polygonal tundra	Sedge-moss-vegetation
48.	Levinson-Lessing Lake region, Thermokarst Lake	Coastal sedge
49.	A scarp of Krasnaya river, 300 m from the mouth vegetation	Herbage-grass-
50.	North-western Levinson-Lessing Lake, the upper slope part 250 m above sea level	Soil under lichen
51.	Near-mouth area of Krasnaya river	Oil under Cotton-sedge-grass vegetation

56.	Hillocky slope of the 1st terrace of Krasnaya river, in 700 m from the mouth	Soil under moss-herbage shrub vegetation
57.	The nivation niche of the southern exposition, at the eastern tip of a 100 m terrace vegetation	Soil under moss- shrub
58.	Polygonal tundra	Soil under sedge-moss vegetation
59. grass	A scarp of Krasnaya river, 300 m from the mouth	Soil under herbage- vegetation
60. flows	The north-western Levinson-Lessing Lake	Algae of temporary water
61.	Thermokarst Lake, Levinson-Lessing Lake area	Algae

11.2: Tables of first results

11.2-1: Preliminary list of plant species found during the Taymyr/Severnaya Zemlya expedition 1995

Dominant species are marked by an asterix (*), species which were determined from collections are marked by a dollar ($). GPS positions by courtesy of Prof. Dr. S. Tahahashi, Kitami Inst. of Technology, Kitami, Japan

1) Labaz Lake area

a) Vascular plants

Aconitum sp
Aster sp.
Astragalus sp. (*)
Betula nana (*)
Calamagrostris neglecta
Casiope tetragona
Cerastium maximum
Chrysanthemum bipinnatum
Draba sp.
Dryas octopetala (*)
Epilobium latifolium
Eriophorum vaginatum
Gentiana spp.
Hierocloe alpina
Ledum palustris
Melandrium Taymyrense
Minuartia macrocarpa
Myosotis alpestris
Pedicularis sp. (*)
Polygonum bistorta
P. viviparum
Ranunculus reptans
Rumex Arcticus
Salix glauca (*)
S. polaris
Saxifraga cernua
S. bronchialis
S. hirculus
Stellaria edwardii
Tripleurosporum sphaerocephalum

b) Mosses

Aulacomnium palustre
A. turgidum (*)
Anthoceros sp.
Bartramia ityphylla (*)
Bryum cryophilum
Bryum spp.
Calliergon giganteum
C. sarmentosum

C. stramineum
Calypogeia sp.
Campyliadelphus stellatus
Cinclidium Arcticum
Dicranum spadiceum
Dicranum spp.
Ditrichum flexicaule
Gymnomitrion coralioides
Hylocomium splendens (*)
Meesia triquetra
Philonotis sp.
Ptilidium ciliare (*)
Polytrichum strictum
Racomitrium lanuginosum
Rigodiadelphus rugosum
Sanionia uncinata
Scorpidium turgescens
Sphagnum spp.
Tomenthypnum nitens (*)

c) Lichens

Dactilina Arctica

2) Levinson-Lessing Lake [N74°32'18" E98°35'57"], August 6, 1995

a) Vascular plants

Artemisia borealis
Astragulus alpinus (*)
Carex rupestris
Carex spp.
Casiope tetragona (*)
Crysanthemum Arcticum
Draba spp.
Dryas octopetala (*)
Elymus interior
Eriophorum vaginatum
Hierachloe alpina
Lagotis glauca subsp. minor
Ledum palustris
Luzula confusa (*)
Melandrium affine
Mysotis alpestris
Novosieversia glaciale (*)
(Geum glaciale)
Oxyria digyna (*)
Papaver polare (*)
Pedicularis sp.
Phlojodicarpus villosus
Polygonum viviparum (*)

Rumex Arcticus
Salix polaris
Salix sp.
Saussurea tilesii
Saxifraga cernua
S. bronchialis subsp. funstonii
S. caespitosa (*)
S. hieracifolia
S. hirculus
S. nivalis
S. platysepala (*)
S. punctata
Stellaria longipes
Taraxacum officinale

b) Ferns

Equisetum varigatum

c) Mosses

Abietinella abietina
Aulacomnium palustre (*)
A. turgidum (*)
Bartramia ityphylla (*)
Bryum cryophilum
Bryum spp.
Calliergon stramineum
Campylophus sp.
Cinclidium Arcticum
Dicranoweisia sp.
Dicranum sp.
Ditrichum pallidum
Drepanocladus revolvens
Hygrohypnum luridum
Hylocomium splendens (*)
Pohlia cruda
Pohlia sp.
Polytrichum strictum
Pottia heimii
Ptilidium ciliare (*)
Rhizomnium sp.
Rigodiadelphus rigosum
Sanionia uncinata (*)
Sphagnum subsecundum
S. squarrosum
Sphagnum spp.
Splachnum ampullaceum
Tortula sp.

d) Lichens

Alectoria sp.
Asahinaea spp.
Caloplaca sp.
Cetraria nivalis (*)
C. cuculata (*)
Cladonia sp.
Dactilina Arctica (*)
Parmelia sp.
Peltigera sp.
Solonia saccata

3) Prima Station [N79°16'44" E101°37'24"] August 8, 1995 and lake areas near Prima Station [N79°16'40" E101°40'34"] August 9, 1995, [N79°15'13" E101° 49'16"].

a) Vascular plants

Alopecurus alpinus (*) ($)
Cerastium ? ($)
Deschampsia sp. ($)
Draba sp. ($)
Novosieversia glacialis (*)
Papaver polare (*)
Poa abbreviata ($)
P. Arctica ($)
Saxifraga cernua (*) ($)
S. caespitosa ($)
S. nivalis ($)
Stellaria?
(Minuartia?)

b) Mosses

Andreaea spp. (*)
Aulacomnium turgidum (*) ($)
Bryum cryophilum (*) ($)
Calliergon giganteum
C. obtusifolium ($)
C. sarmentosum ($)
C. giganteum ($)
Campylophus sp.
Dichodontium sp. ($)
Dicranoweisia crispula (*) ($)
Dicranum sp.
Ditrichium sp. ($)
Drepanocladus revolvens
D. exannulatus
Jungermannia sp. ($)
Orthothecium chryseum (*) ($)
Philonotis sp.

Ptilidium ciliare (*) ($)
Racomitrium lanuginosum (*)
Sanionia uncinata (*)
Schistidium apocarpum ($)
Scorpidium turgescens

c) Lichens

Alectoria sp. ($)
Caloplaca sp. ($)
Cetraria cuculata (*)
C. nivalis (*)
Cladonia spp. ($)
Cornicularia sp.
Dactylina Arctica (*) ($)
Dermatocarpon sp. ? ($)
Ochrolechia frigida (*) ($)
Sphaerophorus sp.
Stereocaulon sp. ($)
Thamnolia vermicularis (*) ($)
Thamnolia sp.
Umbilicaria sp.
Xanthoria elegans (*) ($)
X. sp. ($)

4) North coast of October Revolution Island [N80°05'59" E95°45'23"], August 10, 1995

a) Vascular plants

Cerastium sp.
Saxifraga caespitosa (*)

b) Mosses

Aulacomnium turgidum (*)
Dicranum sp.
Philonotis sp.
Sanionia uncinata
Tortura sp.

c) Lichens

Ochrolechia sp.

5) Komsomolsk Island, north edge of Akademik Nauk Glacier [N80°50'13" E96°19'08"], August 10, 1995

a) Vascular plants

Cerastium biatynickii (*) ($)

b) Mosses

Bryum sp. (*) ($)
Pogonatum sp. (*) ($)

6) Lake south of Akademik Nauk Glacier [N80°10'48" E94°07'05"], August 10, 1995

a) Vascular plants

- Cerastium rugelii ? ($)
- Papaver polare (*)
- Saxifraga caespitosa (*)
- S. oppositifolia (*)

b) Mosses

- Bryum cryophilum (*) ($)
- Ditrichum flexicaule (*) ($)
- Drepanocladus revolvens ($)
- Orthothecium chryseum (*) ($)
- Philonotis sp. ($)
- Pogonatum sp. ($)
- Sanionia uncinata (*) ($)
- Tomenthypnum nitens (*) ($)
- Tortula sp. ($)

c) Lichens

- Candelariella sp. (*) ($)
- Cetraria nivalis
- Cetraria spp. ($)
- Cornicularia sp. ($)
- Hypogymnia sp. ($)
- Parmelia sp. ($)
- Ochrolechia sp. (*) ($)
- Thamnolia vermicularis (*) ($)

7) Near rookery (Rissa tridactyla) at Fjord Lake at October Revolution Island [N79°22'45" E97°44'22"], August 10, 1995

a) Vascular plants

- Deschampsia brevifolia (*)
- Draba spp.
- Papaver polare (*)
- Phippsia sp.
- Saxifraga caespitosa (*)
- S. oppositifolia (*)
- Salix polare (*) ($)

b) Mosses

- Dicranum sp.
- Ditrichum flexicaule (*)

Hylocomium spendens var. alaskanum (*) ($)
Orthothecium chryseum ($)
Pogonatum sp. (*)
Polytrichum sp. ($)
Sanionia uncinata
Schistidium apocarpum (*) ($)
Tortura sp.

c) Lichens
Cetraria sp. (*)
Cladia sp. (*)
Cornicularia sp.
Ochrolechia sp. (*) ($)
Parmelia sp.
Ramalina sp.
Thamnolia vermicularis (*)
Thamnolia sp. ($)
Xanthoria elegans (*)

8) East of Karpinskogo Glacier [N79°36'30" E97°11'18"], August 11, 1995

a) Vascular plants
Deschampsia sp. (*)
Eritrichium villosum
Papaver polare (*)
Saxifraga oppositifolia (*)

b) Lichens
Buellia sp.
Cetraria nivalis (*)
Lecidea sp.
Ramalina sp.
Thamnolia vermicularis

9) North of Vavilova Glalcier [N79°32'14" E95°44'16"], August 11, 1995

a) Vascular plants
Draba sp. (*)
Papaver polare (*)
Saxifraga oppositifolia (*)

b) Mosses
Bryum sp. c. fr.
Dicranum sp. c. fr.
Ditrichum sp. c. fr.

10) Sredny Island, runway area [N79¯31'13" E91¯09'01"], August 11, 1995

a) Vascular plants

Deschampsia sp. (*)

b) Mosses

Bryum argentum
B. cryophilum (*)
Bryum sp.
Calliergon sp. ($)
Desmatodon sp. ($)
Pottia heimii

11) Coast of Izmentchivoe Lake, October Revolution Island [N79°06'10" E91°12'04"], August 11, 1995

a) Vascular plants

Cerastium sp.
Papaver polare (*)
Saxifraga oppositifolia (*)

b) Mosses

Ditrichum sp.
Loeskypnum badium
Orthothecium chryseum (*)
Sanionia uncinata (*)

c) Lichens

Cetraria nivalis ?
Lecidea sp.
Thamnolia vermicularis (*)

12) Mushkitova Glacier, side moraine, Bolshevik Island [N79°10'02" E102°09'34"], August 12, 1995

a) Mosses

Andreaea sp.
Bryum sp.
Dicranoweisia sp.
Dicranum sp.
Pogonatum sp.

b) Lichens

Alectoria sp. (*)
Buellia sp.
Cetraria sp. (*)
Lecanora sp.
Lecidea sp.
Ochrolechia sp. (*)
Parmelia sp. (*)
Peltigera (Dermatocarpon?) sp.

Rhizocarpon sp.
Stereocaulon sp.
Umbilicaria sp.
Xanthoria sp.

Other places visited for short stopovers were only roughly inspected:

- Taymyr Polar Station [N74°36'40" E101°31'12"], August 8, 1995. Dominant vacular plant was Alopeculus alpinus, and mosses were Calliergon giganteum, C. stramineum, Drepanocladus fluitans, and Tomenthypnum nitens.

- Riverside Station [N76°20'54" E102°20'46"], August 8, 1995. Dominant moss was Tomethypnum nitens.

- Cape Cheluskin [N77°43'09" E104°15'40"], August 13, 1995. Vascular plants were Artemisia sp., Calamagrostris neglecta, Carex sp. (aquatilis?), Deschampsia sp., Glechroma hederacea, Poa sp., and mosses were Bryum sp. and Ceratodon sp.

11.2-2: Expedition Taymyr/Severnaya Zemlya 1995
Birds observed [n] during the expedition (Aug. 5-12, 1995)

a) Levinson-Lessing Lake (Aug. 5 - 7, 1995)

Gavia arctica (L.)/ Black-throated diver/ Prachttaucher [1,1]
Clangula hyemalis (L.)/ Long-tailed Duck/ Eisenten [flocks]
Buteo lagopus (Pontoppidan)/ Rough-legged Buzzard/ Rauhfußbussard [1]
Pluvialis apricaria (L.)/Golden Plover /Goldregenpfeifer [1]
Calidris minutus (Leisler)/Little Stint /Zwergstrandläufer [1]
Larus argentatus (Pontoppidan)/ Herring Gull/ Silbermöwe [flock of 6]
Larus hyperboreus(Gunnerus)/ Glaucous Gull/ Eismöwe [1]
Nyctea scandiaca (L.)/ Snowy owl/ Schnee-Eule (observed by. E.M.Pfeiffer) [1]
Plectrophenax nivalis (L.)/ Snow Bunting/ Schneeammer [flocks]

b) Cape Cheljuskin

Somateria spectabilis (L.)/ King Eider/ Prachteiderenten [flocks]
Stercorarius pomarius (Temminck)/ Pomarine Skua/ Spatelraubmöwe [3]
Larus argentatus (Pontoppidan)/ Herring Gull/ Silbermöwe [9]
Larus hyperboreus (Gunnerus)/ Glaucous Gull/ Eismöwe [6]
Sterna paradisea (Pontoppidan)/ Arctic Tern/ Küstenseeschalben [2]

c) Bolschevik Island

Pagophila eburna (Phibbs)/ Ivory Gull/ Elfenbeinmöwen [flocks]
Larus sabini (Sabine)/ Sabine's Gull/ Schwalbenmöwe [1]
Rissa tridactyla (L.)/ Kittiwake/ Dreizehenmöwen [colony, ~60PP]
Sterna paradisea (Pontoppidan)/ Arctic Tern/Küstenseeschwalben [2]
Plectrophenax nivalis (L.)/ Snow Bunting/ Schneeammer [flocks]

d) Octoberrevolution Island

Larus marinus (L.)/ Great Black-backed Gull/ Mantelmöwen [2]
Larus hyperboreus (Gunnerus)/ Glaucous Gull/ Eismöwe [5]
Rissa tridactyla (L.)/ Kittiwake/ Dreizehenmöwe;
colony, ca. 120PP, at cliffs of Fjordlake [N79° 22' 44" E97° 44' 10"]
Sterna paradisea (Pontoppidan)/ Arctic Tern/ Küstenseeschwalbe [1]

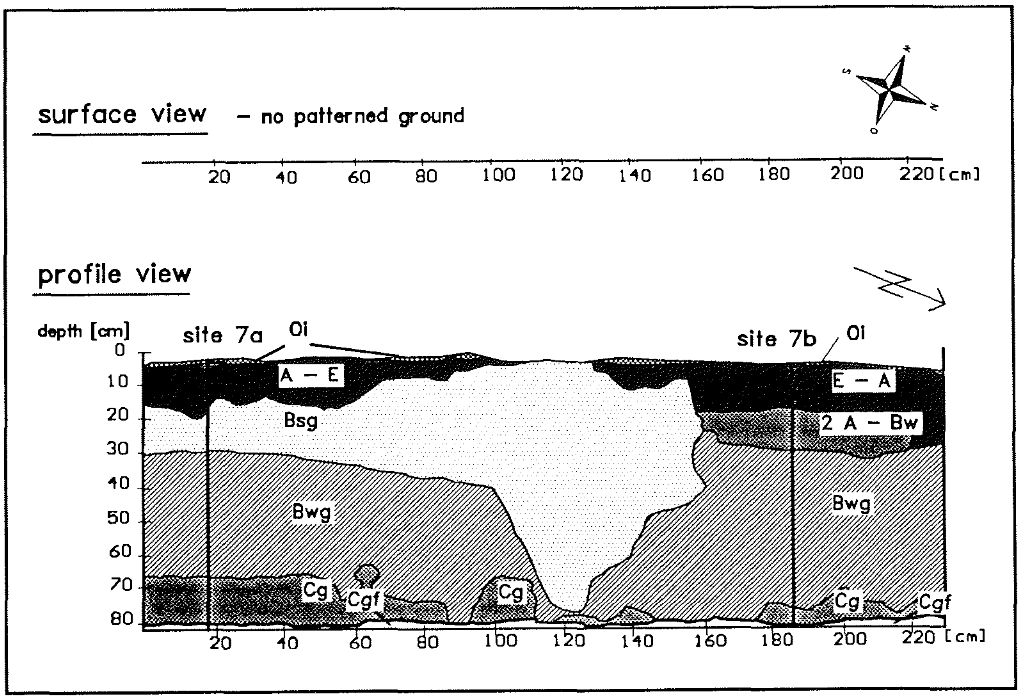
e) Sredny Island

Pagophila eburna (Phibbs)/ Ivory Gull/ Elfenbeinmöwen [2]
Larus sabini (Sabine)/ Sabine's Gull/ Schwalbenmöwe [1]
Rissa tridactyla (L.)/ Kittiwake/ Dreizehenmöwen [flocks]
Sterna paradisea (Pontoppian)/ Arctic Tern/ Küstenseeschwalben [2]

11.3: Characterization of selected soil sites

SITE 7: sandy, nonacid Pergelic Cryaquept

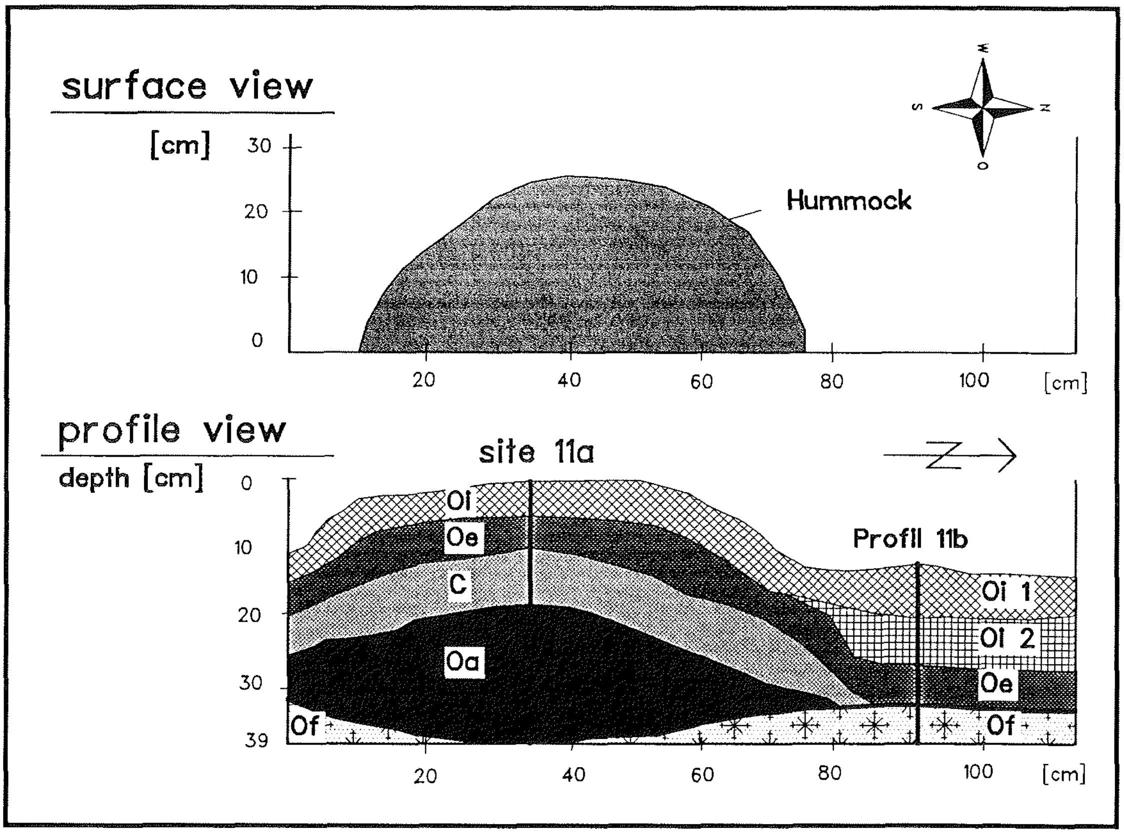
location:	North-Siberia, Taymyr Peninsula, northern shore Lake Labaz (72° N, 99° E).
climate:	continental; mean annual air temperature -13,4 °C, mean july air temperature +12,3 °C, mean annual precipitation 237.
landform:	moderatly hilly, lake depression, strong solifluction and thermokarst. Site 7 ca. 5 m above ground of Tolton-Valley, lower slope.
altitude:	50 m a.s.l.
vegetation:	dry type of subarctic treeless tundra with lichens (*Bryocaulon divergens, Cetraria cucullata*), mosses (*Polytrichum strictum*), grass (*Poa glauca*) and small shrubs (*Betula nana, Cassiope tetragona*).
parent material:	fluvioglacial sand.
patterned ground:	none
pedogenesis:	low accumulation of organic material, week podzolisation, gleying, cryoturbation ,wind erosion.
soil properties:	dry, low nutrient availability.



depth (cm)	horizon	description
- 1 - 0	Oi	slightly decomposed plant material, dominated by lichens and mosses.
0 - 10	A-E	dark brown (10YR3/4), week humic, medium sandy, partly pale, strong rooted.
10 - 25	Bsg	brown (7,5 YR4/4), very week humic, < 1% rock fragments, medium sandy, strong rooted.
25 - 60	Bwg	brown (10YR4/4), < 1 % rock fragments, medium sandy, no roots, gleyic.
60 - 80	Cg	grayish olive (5Y5/2), < 1 % rock fragments, medium sandy, no roots, gleyic.
> 80	Cgf	grayish olive (5Y5/2), medium sandy, no ice lenses, permafrost boundary.

SITE 11: **Pergelic Cryofibrist**

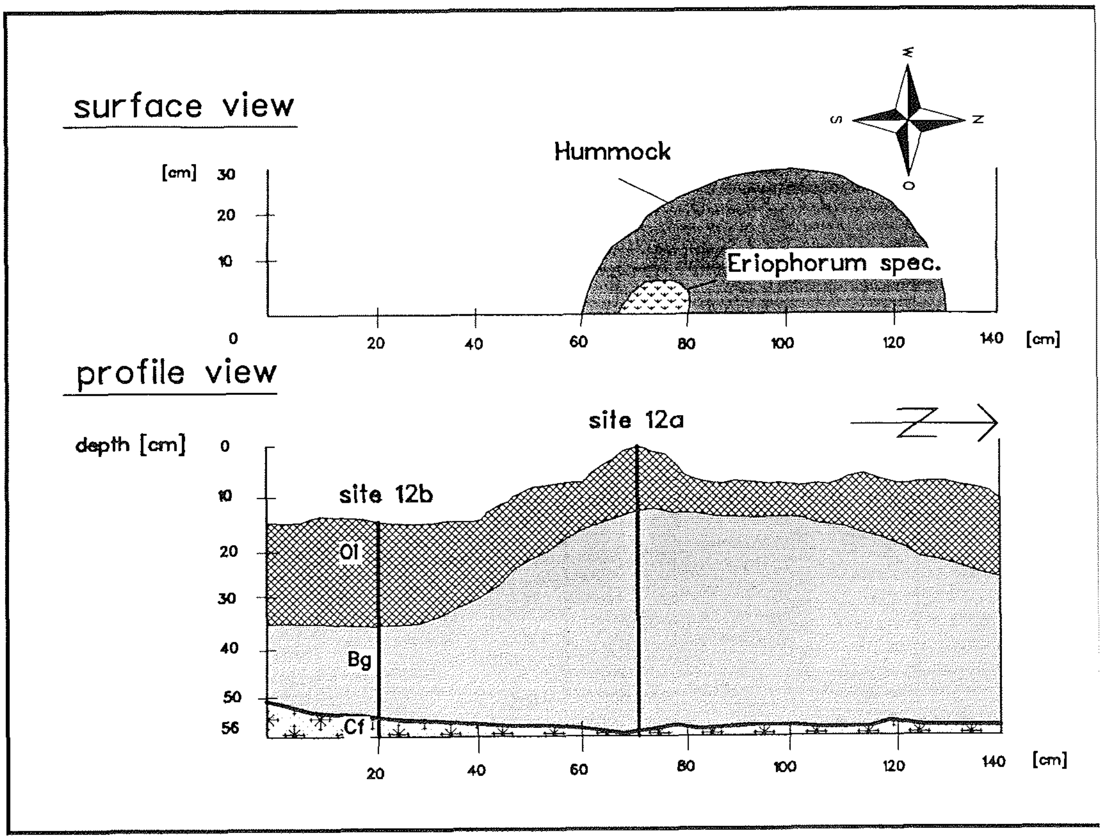
location:	North-Siberia, Taymyr Peninsula, northern shore Lake Labaz (72° N, 99° E).
climate:	continental; mean annual air temperature -13,4 °C, mean july air temperature +12,3 °C, mean annual precipitation 237 mm.
landform:	moderatly hilly, lake depression, strong solifluction and thermokarst. Site 11 ca. 5 m above ground of Tolton-Valley.
altitude:	50 m a.s.l.
vegetation:	dry type of subarctic, treeless tundra with lichens (*Cetraria cucullata*), mosses (*Kiaeria starkei*), grass (*Carex bigelowii sibiriarctica*) and small shrubs (*Betula nana, Ledum decumbens*).
parent material:	peat
patterned ground:	unsorted circles, Earth Hummocks.
pedogenesis:	strong accumulation of organic material.
soil properties:	dry, low nutrient availability.



depth (cm)	horizon	description
0 - 5	Oi	dark brown (7,5YR3/4), slightly decomposed peat, strong rooted.
5 - 10	Oe	brownish-black (10YR2/2), medium decomposed peat, very strong rooted.
10 - 19	C	dark brown (10YR3/3) loam, < 1% rock fragments, medium rooted.
19 - 36	Oa	black (10YR1,7/1), strong decomposed peat, very strong rooted.
> 36	Of	frozen peat, ice lenses, permafrost boundary.

SITE 12: loamy, nonacid Pergelic Cryaquept

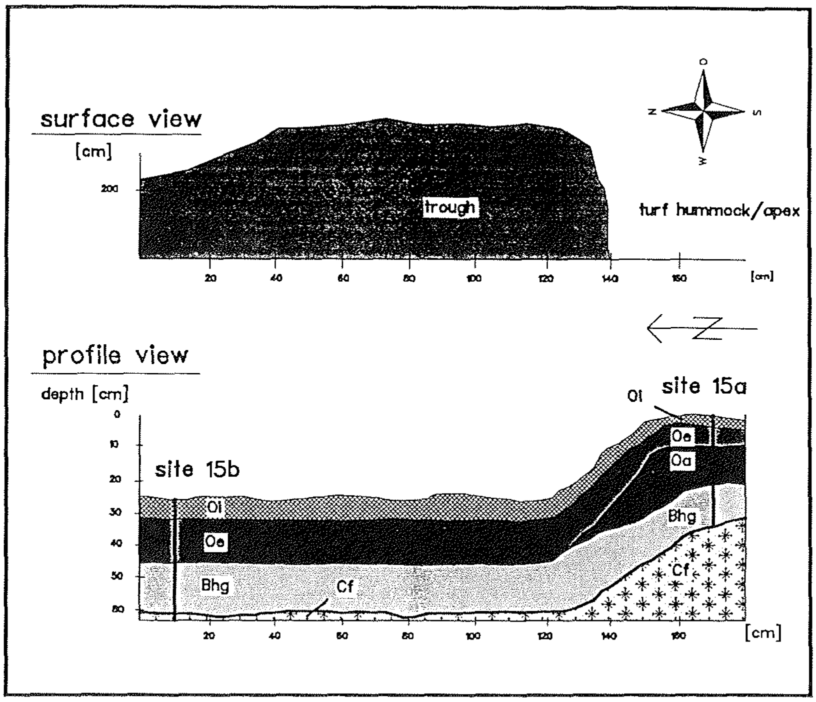
location:	North-Siberia, Taymyr Peninsula, northern shore Lake Labaz (72° N, 99° E).
climate:	continental; mean annual air temperature -13,4 °C, mean july air temperature +12,3 °C, mean annual precipitation 237 mm.
landform:	moderatly hilly, lake depression, strong solifluction and thermokarst. Site 12 lower slope.
altitude:	50 m a.s.l.
vegetation:	wet type of subarctic, treeless tundra with mosses (*Hylocomnium splendens, Tormenthypnum nitens, Aulacomnium turgidum*) and small shrubs (*Betula nana*) in the trough, lichens (*Bryocaulon divergens, Aerophotorus globosus*), mosses (*Anastrophyllum minutum*), grass (*Eriophorum vaginatum*) and small shrubs (*Vaccinium vitis-idea*) at the apex.
parent material:	clayey loam.
patterned ground:	nonsorted circles, Earth Hummocks
pedogenesis:	gleying, accumulation of organic material.
soil properties:	very wet.



depth (cm)	horizon	description
-10- 0	Oi	black (7,5YR2/1), slightly decomposed plant material, very strong rooted.
0 - 44	Bg	darl olive brown (2,5Y3/3), week humic, sandy loam, <1% rock fragments, medium rooted, gleyic.
> 44	Cf	frozen loam, small ice lenses, permafrost boundary.

SITE 15: histic Pergelic Cryaquept

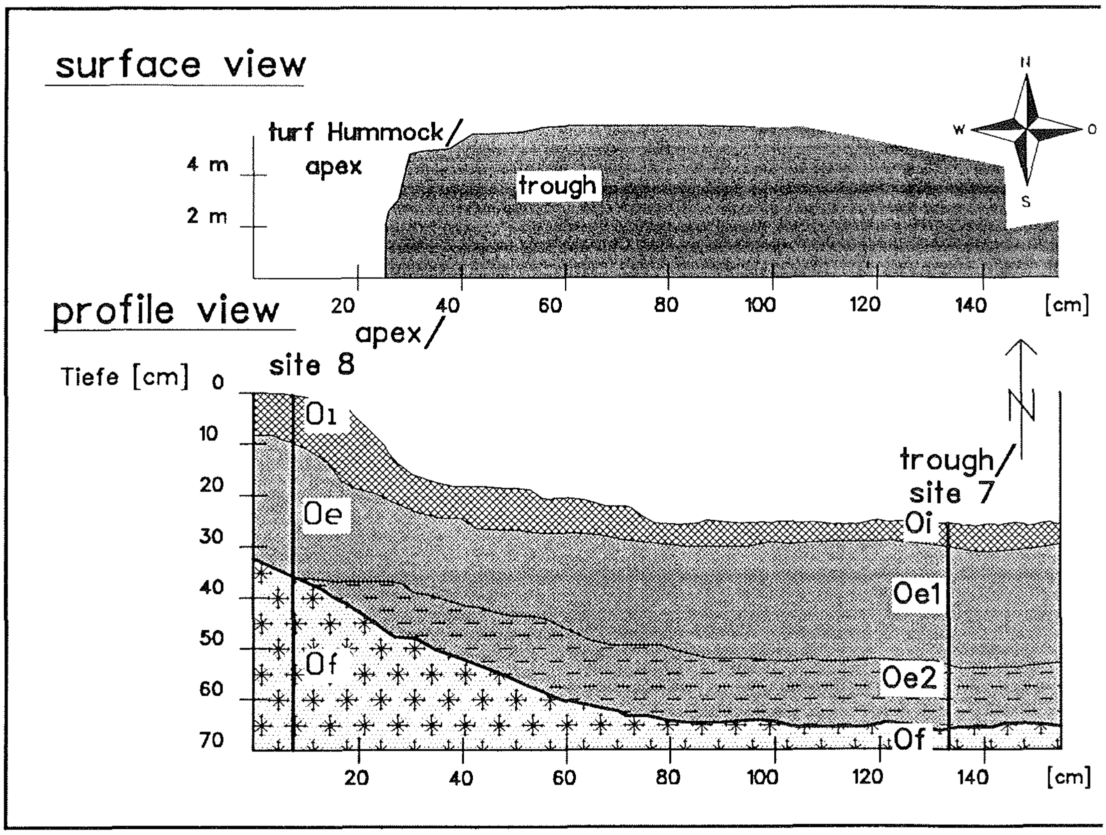
location:	North-Siberia, Taymyr Peninsula, northern shore Lake Labaz (72° N, 99° E).
climate:	continental; mean annual air temperature -13,4 °C, mean july air temperature +12,3 °C, mean annual precipitation 237 mm.
landform:	moderatly hilly, lake depression, strong solifluction and thermokarst. Site 15 in a depression on the ground of a former lake.
altitude:	50 m a.s.l.
vegetation:	very wet type of subarctic treeless tundra with mosses (*Drepanocladus uncinatus, Plagomnium elatum*) and grass (*Carex stans*) in the trough, dry type of subarctic tundra with lichens, mosses (*Polytrichum strictum, Kiaeria starkei*) and small shrubs (*Betula nana, Vaccinium vitis-idea*) at the apex.
parent material:	peat, underlain by loamy lake sediments.
patterned ground:	nonsorted, low centred polygons
pedogenesis:	strong accumulation of organic material, gleying.
soil properties:	very wet (trough), moderate dry (apex).



depth (cm)	horizon	description
-20 - -17	Oi	very dark brown (7,5YR2/3), slightly decomposed plant material, very strong rooted.
-17 - -9	Oe	dark brown (7,5YR3/3), medium decomposed plant material, very strong rooted.
-9 - 0	Oa	dark brown (7,5YR3/3), strong decomposed peat, very strong rooted.
0 - 9	Bhg	brownish black (10YR3/2), medium humic, clayey loam, week rooted, gleyic.
> 9	Cf	frozen peat, ice lenses (ca. 90 Vol.-% ice content), permafrost boundary.

SITE 7: Pergelic Cryofibrist

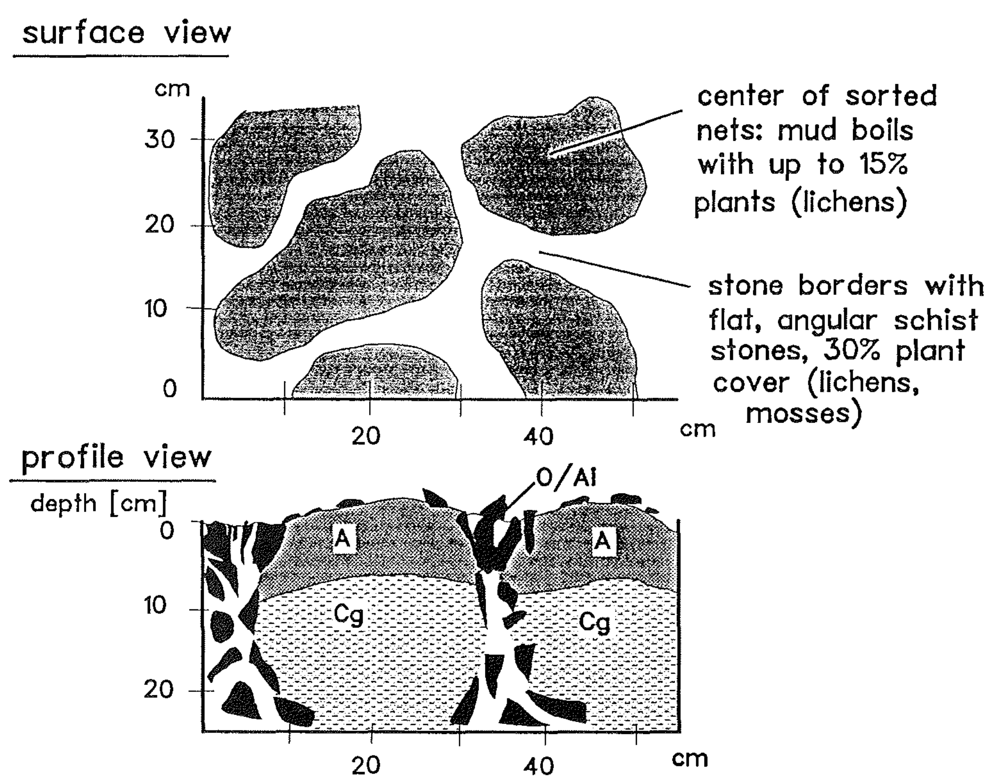
location:	North-Siberia, Taymyr Peninsula, north-west shore Lake Levinson Lessing (74° N, 98° E).
climate:	continental; mean july air temperature 1995: +9,9 °C,
landform:	hilly, lake depression, strong solifluction and thermokarst. Site 7 near Lake shore.
altitude:	50 m a.s.l.
vegetation:	very wet type of subarctic treeless tundra wit mosses and grass (*Carex spec., Eriophorum spec.*) and small shrubs.
parent material:	peat, sand (fluviatil deposits).
patterned ground:	low centred ice wedge polygons.
pedogenesis:	accumulation of organic matter, gleying.
soil properties:	very wet (trough), moderate dry (apex)



depth (cm)	horizon	description
0 - 5	Oi	black (7,5YR2,5/1), slightly decomposed peat, strong rooted.
5 - 28	Oe1	black (10YR2/1), medium decomposed peat, very strong rooted.
28 - 40	Oe2	brownish-black (2,5Y2,5/1), medium decomposed peat, strong rooted.
> 40	Of	frozen peat, ice lenses, permafrost boundary.

SITE 1b(BI1/Bölter): loamy-skeletal, mixed, nonacid, Pergelic Cryaquept

location:	Severnaya Zemlya, Bolschevik Island (79°16'40"N, 101°40'34"E).
date:	August 9, 1995
vegetation:	mosses, lichens,grass (*Carex spec*).
parent material:	alluvial deposit of silt stone, fine silty-loamy-skeletal sediments.
patterned ground:	weak sorted nets (mudboils), some spots with nonsorted nets.
permafrost:	> 48 cm depth.
hydrology:	wet slope near lake depression



Profile net center:

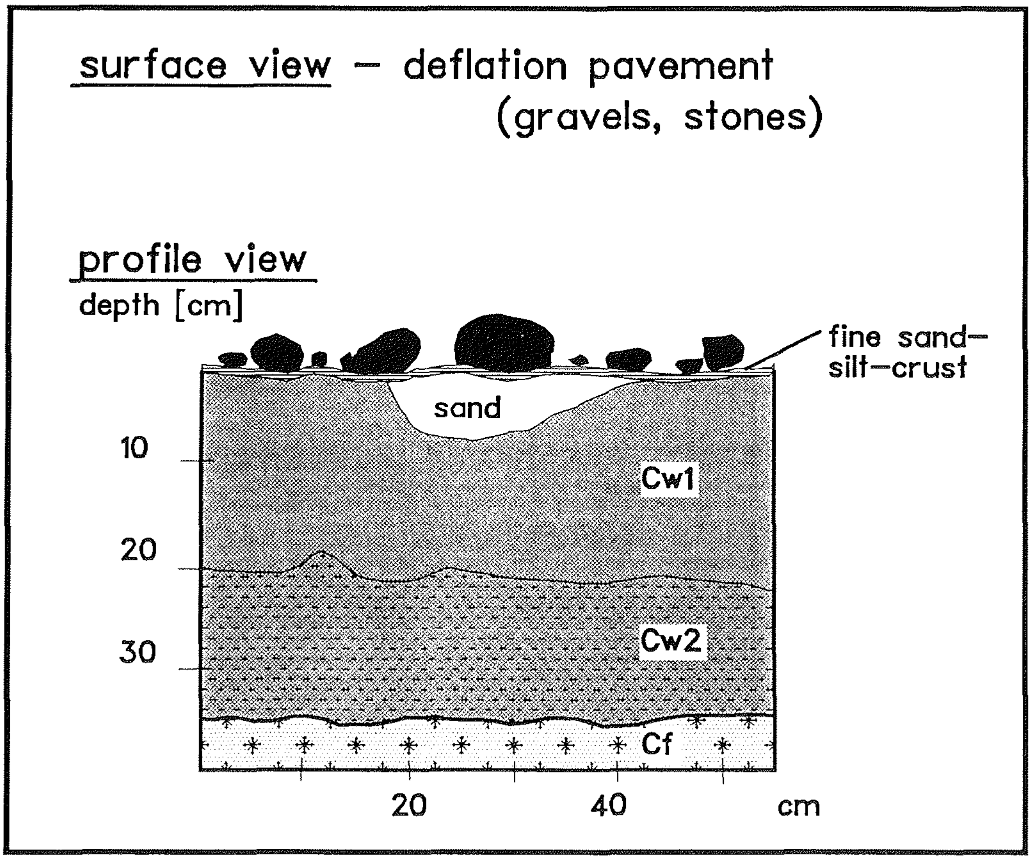
depth (cm)	horizon	description
0 - 10	A	silty sand with 25% flat, fine gravels (fGr3) and some stones (fX2)
10 - 48	lCg	silty sand with 75% flat, fine gravels (fGr5) and 10% stones (fX1), weak Fe^{2+}, free water
> 48	Cf	permafrost boundary

Profile stone border:

0 - 2	O/Ai	some spots with silty sand, 35% plant cover
> 2	C	flat/angular , medium and coarse gravels (mgG2) and stones (fX6), free water

SITE 3 (KI1/Bölter, Lok1/Hubberten): Pergelic Cryopsamment

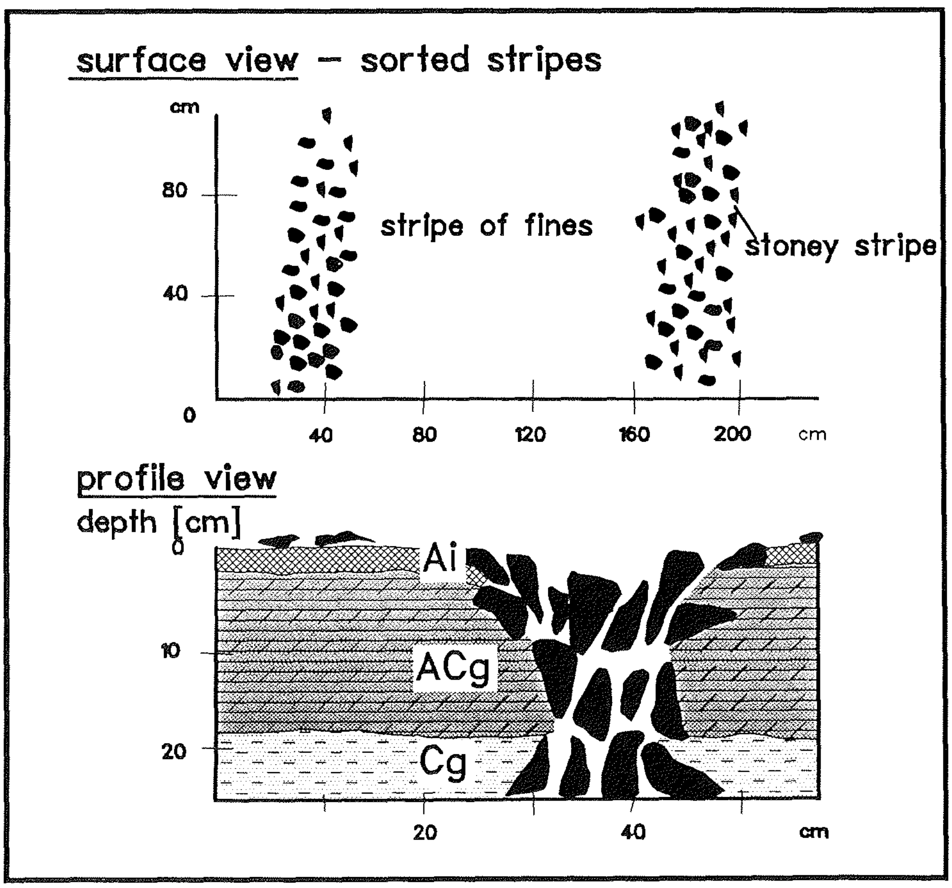
location:	Severnaya Zemliya, Komsomolsk Island, Edge of Academik Nauk Glacier (80°50'11"N, 96°18'55"E).
date:	August 10, 1995.
vegetation:	polar desert, spots with single mosses.
parent material:	out wash of sands (mS) with < 2% fine-coarse gravels.
patterned ground:	deflation pavement of coarse gravels and stones (6-20 cm, honey coloured chalcedon).
permafrost:	> 35 cm depth.
hydrology:	relative dry.



depth (cm)	horizon	description
0 - 2		"silt crust"-surface with coarse gravels and fine stones (fO-subrounded-rounded stones).
2 - 20	Cw1	coarse sand with 2-10% gravels, yellow (2.5Y7/6), lense of fine sand, single grain structure.
20 - 35	Cw2	coarse sand with 2% gravels, pale yellow(2.5Y7/4), single grain structure.
> 35	Cf	permafrost boundary.

SITE 9 (OR5/Böl., Lok6/Hubb.): sandy-skeletal, mixed, calcareous Pergelic Cryaquept

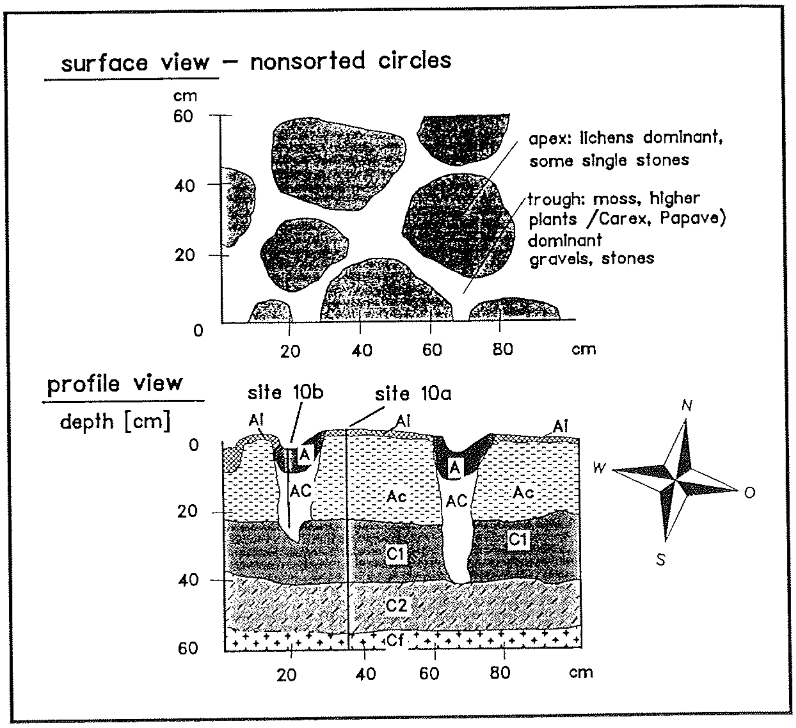
location:	Severnaya Zemliya, October Revolution Island, Izmentchivoe Lake (veränderlicher roter See; 79°06'10"N, 95°12'04"E), Dimas special site (sampling 1996/97).
date:	August 11, 1995.
vegetation:	mosses, lichens, Saxifraga opp., 3% coverage.
parent material:	debris of red sandstone, >75% coarse gravels (fG5) with lS (fine earth texture).
patterned ground:	steep slope: sorted stripes.
permafrost:	> 25 cm depth.
hydrology:	wet, slope water.



depth (cm)	horizon	description
0 - 2	Ai	loamy sand with 25% fine subrounded gravels (fG3), some stones (fO1), weak red-reddish grey (2,5YR4/2; 5/1), roots (w2).
2 - 18	ACg	loamy sand with 75% subrounded fine gravels, reddish-grey (2.5YR5/1), no Fe^{2+}-reaction.
18 - 25	Cg	subrounded coarse gravels (gG6), reddish grey(7.5YR6/1), weak Fe^{2+}-reaction, free water, stone colour 7,5YR3/4.
> 25	Cf	permafrost boundary.

SITE 10 (Lok7/Hubberten): clayey-skeletal, mixed, nonacid, Pergelic Cryaquept

location:	Severnaya Zemliya, Bolschewik Island, Lake Trovdoja (max. depth 7 m, drinking water for prima station, fish:arctic Shar; 79°15'13"N, 101°49'16"E).
date:	August 12, 1995.
vegetation:	mosses, lichens, Papaver polare, Carex arctisiberia.
parent material:	alluvial sands/gravels with a fine earth texture of clayey silt.
patterned ground:	nonsorted circles.
permafrost:	> 47 cm depth.
hydrology:	very wet, slope near lake.



Profile 10a/apex

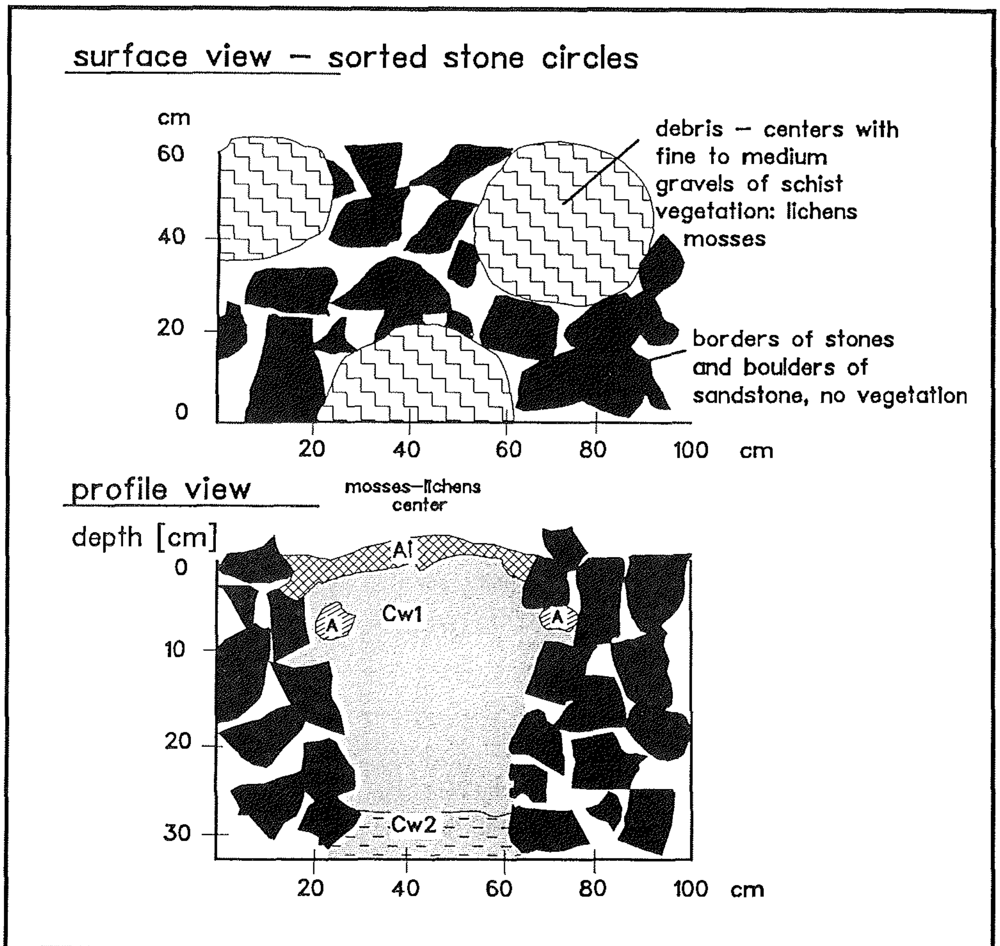
depth (cm)	horizon	description
0 - 1	Ai	loamy silt with 10% fine gravels, olive brown (2,5Y4/3), massive structure.
1 - 22	AC	silty sand with 25% medium gravels, light olive brown (2.5Y5/3), single grain structure.
22 - 38	C1	medium sand with 50% medium gravels, greyish brown (2.5Y5/2).
38 - 47	C2	medium sand with 75% coarse gravels, light brownish grey (2,5Y6/2).
> 25	Cf	permafrost boundary.

Profile 10b/trough

0 - 4	A	clayey silt (tU) with 25% medium gravels and 5% stones, dark olive brown (2.5Y3/3), massive structure.
4 - 20	AC	loamy silt (lU) with 25% coarse gravels and 10% stones, light olive brown (2.5Y5/3).

SITE 12a (BI6/Bölter, Lok9/Hubberten): fragmental, mixed, nonacid, Pergelic Cryorthent

location:	Severnaya Zemliya, Bolschewik Island, north lope of Mosqueta Glacier, since 1980 glacier transgress, site near border of glacier (79° 10'35"N, 102°09'07"E).
date:	August 12, 1995.
vegetation:	mosses (Polytrichum spec.), lichens.
parent material:	detris of coarse sandstone and fine clay schist.
patterned ground:	sorted circles (borders with sandstone, center with clay schist).
permafrost:	?, > 85 cm depth.
hydrology:	dry.



depth (cm)	horizon	description
0 - 2	Ai	middle sand with 50% fine-medium, angular gravels (fmGr4), 10% stones (X2), very dark greyish brown (2.5Y3/2).
2 - 30	Cwl	middle, angular gravels (mGr6), 50% angular stones (fmX4), stone colour: 2.5Y4/2.
> 30	Cw2	coarse angular gravels (gGr3), >75% stones (mX6), stone colour: 2.5Y4/1

11.4 Participating scientists and institutions

11.4-1 Expedition participants

Russian participants		Stages
Anisimov, M. A.	AARI	3
Antonov, O. M.	AARI	3
Bolshiyanov, D. Yu.	AARI	1, 3
Danilov, I. V.	AARI	4
Derevyagin, A. Y.	MSU	3
Fedorov, G. B.	AARI	3
Ivanov, A.Yu.	AARI	2, 3
Mescherjakov, V. G.	AARI	1, 2, 3, 4
Panasenkova, O.I.	RINCAN	3
Petukhov, A.V.	AARI	1
Savin, V. B.	AARI	4
Scherbakov, Yu. S.	AARI	3
Seleznev, P. V.	AARI	3
Troshin, E. V.	MSU	3
Ufimtsev, A.V.	AARI	1, 2, 3, 4
Zhurbenko, M. P.	KBI	3
Zimichev, V. P.	AARI	2, 3
German participants		
Boike, Julia	AWI	2,4
Becker, Holger	IBH	3
Bolter, Manfred	IPÖ	3
Ebel, Tobias	AWI	1
Gintz, Dorothea	UHW	2,3
Guggenberger, Georg Anton	IBB	3
Gundelwein, Andreas	IBH	3
Hagedorn, Birgit	AWI	2
Hubberten, Hans-Wolfgang	AWI	3
Nothen, Thomas	IBH	3
Overduin, Pier Paul	AWI	1,4
Pfeiffer, Eva-Maria	IBH	3
Salzwedel, Ute	AWI	4
Siegert, Christine	AWI	3
Sommerkorn, Martin	IPÖ	3
Vannahme, Gerald	AWI	3
Zielke, Artur	AWI	1
Japan participants		
Kanda, Hiroshi	NIPR	3
Takahashi, Shuhei	KIT	3
Yamanouchi, Takasi	NIPR	3
Watanabe, Okitsugu	NIPR	3

11.4-2 Participating institutions

Federal Republic of Germany

AWI	Alfred-Wegener-Institute for Polar and Marine Research Telegrafenberg A43 14473 Potsdam
IBH	Institute of Soil Science University of Hamburg Allende-Platz 2 20146 Hamburg
IPÖ	Institute of Polar Ecology University of Kiel Wischhofstr. 1-3 24148 Kiel
IBB	Institute of Soil Sciences University of Bayreuth Universitätsstr. 30 95440 Bayreuth
UHW	Martin-Luther-University Halle-Wittenberg Institute of Geography Domstr. 5 06108 Halle

Russia

AARI	Arctic and Antarctic Research Institute ul. Beringa 38 199226 St. Petersburg
MSU	Department of Permafrost Studies Faculty of Geology Moscow State University 119899 Moscow
KBI	Komarov Botanical Institute Russian Academy of Sciences Prof. Popov Str. 2 197376 St. Petersburg

RINCAN	Research Institute for Nature Conservation of the Arctic and the North Tovaryshesky, 28 St. Petersburg

<u>Japan</u>

NIPR	National Institute of Polar Research Itabashi-ku Tokyo 173
KIT	Kitami Institute of Technology Koencho 165 Kitami 090

THE EXPEDITION KOLYMA 1995 OF THE ISSP-PUSHCHINO GROUP

by

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* Institute of Soil Science and Photosynthesis, Russian Academy of Sciences, 142292 Pushchino, Moscow Region, Russia

1. INTRODUCTION

1.1 Objectives

The field work in Kolyma Lowland (N.-E. Siberia) was part of the German-Russian research project "Biogeochemical Investigations on Waters and Sediments of Polar Lakes" sponsored by the German Ministry of Education, Science, Research and Technology, Germany (BMBF).

The main objectives of the project are the study of biogeochemical activity of methane producing and methane oxidizing bacteria in polar lakes, gas exchange at the sediment/water interface, methane content and the number of microorganisms in frozen sediments, mineralogical and geochemical peculiarities of the modern-and paleo-lake sediments related with biogeochemical processes.

Methane emission from tundra wetlands has been studied intensively because of the strong greenhouse effect of this gas and fast increase of its concentrations in the atmosphere. But there are only a few data concerning the biogeochemical methane cycle in polar lakes covering vast expauses of the tundra.

The studies conducted are important for the understanding the role of tundra lakes in the modern global methane budget, for the interpretation of paleoenvironmental information conserved in the lake sediments and permafrost and forecasting changes in tundra carbon budget caused by climate warming.

1.2 Itinerary

The expedition was carried out by a multidisciplinary team of scientists from the Institute of Soil Science and Photosynthesis (Russian Academy of Sciences) and the Centre for Biological Research, Pushchino, Moscow Region, Russia. The participants in the expedition were:

Dr. SAMARKIN, V.A., Project coordinator, Biogeochemist;
Dr. OSTROUMOV, V.E., Geochemist; Dr. GUBIN, S.V., Soil Scientist;
SOROKOVIKOV, V.A., Hydrologist; VISHNEVETSKAYA, T.A., Microbiologist;
GUBIN,D.S., Student of Moscow State University (MSU), Department of Geography;
VLASENKO , A.YU, MSU Student, Department of Geology.

The chief ecologist of the local reserve MOCHALOV, S.I, cook TAKHEEVA , L.N. and the hunter NALETOV, A.A. from Chersky participated in the expedition as volunteers.

The expedition started on August 12, 1995 by plane from Moscow to Yakutsk and than to Chersky. The local transportation to the lake Bol'shoi Oler was carried out on August, 19 by helicopter. The field camp (tents) was set up on the shore of the lake. The field work started on August, 20 and terminated September, 1. Equipment and samples were transported back to Chersky by helicopter and from Chersky to Moscow by a favourable charter flight.

1.3 Characteristics of the study area and sites

The field works were conducted on the lake Bol'shoi Oler situated in the central part of Kolyma Lowland which is a part of the vast East-Siberian Sea Coastal Lowland (Fig. 1a and 1b).

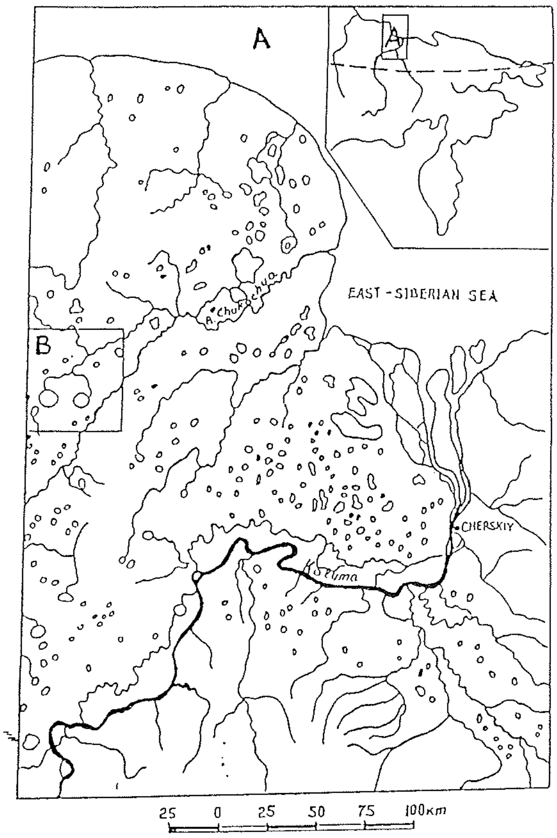


Fig. 1a: Sketch map of the study area - Square B shows the area of Fig. 1b

The climate of the territory is severe, extremely continental. The period with negative mean daily temperatures lasts from September to May. The landscapes include many wetlands and lakes because of precipitation exceeds evaporation, extensively developed thermokarst and universal permafrost. The depth of seasonal thawing varies from 0.2 m in the Arctic tundra to 1 m on the taiga boundary. Soils begin to thaw at the end of May and stop thawing in early September. Freezing is 2 to 3 times quicker. The ages of permafrost sediments range from Pliocene to Holocene. Their temperatures reach -12°C.

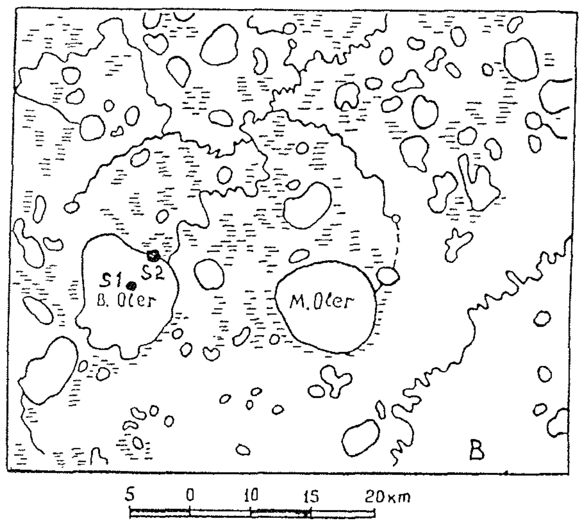


Fig. 1b: Area of Lake B. Oler

In the present view (KAPLINA, 1981) the base of the geological cross section of this area (Fig. 2) is composed of the Olerskaya suite sediments from 3 million to 600 thousand years old accumulated under aquatic, relatively warm conditions. These sediments are quartz-feldspar aleurites and fine grained sands with peat inclusions and streaks containing authigenic vivianite and occasionally iron sulfides.

Sediments of the Oleskaya suite are overlain by Edomic suite aleurites with thick polygonal ice veins. They are 41 000 to 15 000 years old, polygenetic, and formed in a cryo-arid climate. The thickness of the Edomic sediments measured in the exposures on the Bol'shoi Oler lake shore amounts 13–15 m.

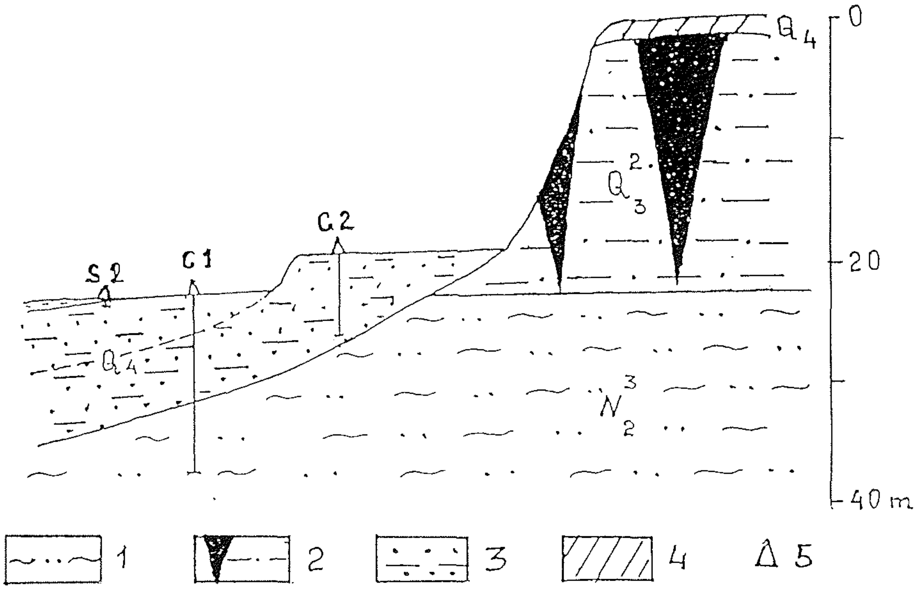


Fig. 2: Sketch of the geological cross-section of the Lake B. Oler area

1 - olerian aleurites
2 - edomic aleurites and fine grain sands with ice veins (black coloured)
3 - alas taberal and lake sediments
4 - covering horizon
5 - position of the sampling sites

The upper part of the sequence consists of sediments formed during the Holocene climate optimum 7600 to 9200 years ago. These sediments fill in the thermokarst depressions (alas). Thermokarst processes strongly reworked the surface of the Edomic plain so that alas depressions of different size and level with lakes alternate with Edomic outliers. The alas complex is characterised by thawed and compacted Edomic aleurites in the lover part (taberal sediments) and by bog-lacustrine facies with high ice content and peat layers 1 to 4 m thick. Bog-lacustrine material and peats are being deposited continuously in alas depressions.

Due to deeper permafrost thaw during the Holocene, covering layer has been formed on the upper part of the Edomic suite. Its thickness varied from 1 m in Arctic tundra to 2 -2.5 m in forested tundra area. The uneven horizon with high ice content lies on the boundary between covering horizon and Edomic sediments.

As it was shown earlier (SAMARKIN et al., 1994), methane is contained in Olerian aleurites (1.3 to 45.5 ml CH_4 per kg of sediments), is almost lacking in the Edomic complex and is presented at alas sediments and covering layer at concentrations ranged from 0.5 to 16.5 ml per kg.

Lake B. Oler is located in the central part of the Kolyma Lowland (Fig. 1b). It is one of the largest typical thermokarst lakes widely occurring here. Its surface area is about 50 km^2. The lake is shallow, and its depth increases gradually from a few centimetres near the shore to 2.5 – 3 m in the central part. Two times (5 and 3 years ago) a sharp drop of the lake level took place caused by erosion of its outflow to the Bol'shaya Chukoch'ya river. The lake depth was decreased about 2.5 m at that and the zone of exposed lake bottom was arized up to 50 m in breadth. Thus, it was possible to sample modern and permafrost lake sediments in this drained zone by drilling to study methane biogeochemistry in them.

The first site (S1) was located in the central part of the lake (2.5 m depth), the second (S2) - 50 m from the shore line (20 cm depth), the third (C1) - in the middle of 3 years old drained bottom zone, the forth (C2) - on the surface of the Holocene alas (2 m higher than the 3rd site).

2 SAMPLING TECHNIQUE AND EXPERIMENTAL METHODS

2.1 Lake and permafrost core sampling

Undisturbed sediment cores were taken from a boat in the central part of the lake using a gravity corer received from AWI-Potsdam. Near-shore lake sediments were taken by direct pressing 60 cm long plastic tubes into the lake bottom. These cores were used for the field experiments and analysis. Four cores were transported to the Institute in Pushchino and two of them to AWI-Potsdam for mineralogical and geochemical studies which have been conducted by Dr. Ch. SIEGERT.

Permafrost sediment cores were recovered by mechanical drilling of two holes with the transportable machine UKB 25. Immediately after taking, the cores were sampled for CH_4 determinations. Special samples were taken with precautions against contamination to determine the number and species composition of microorganisms in frozen lake sediments. These samples were transported from the field in special container in frozen state and are presently under processing in the Laboratory of Soil Cryology ISSP headed by Dr. GILICHINSKY.

2.2 Sediment pore water sampling

Pore waters from the sediments were obtained applying a hand operated Plexiglass press at the day of coring. At the same day, alkalinity of the pore waters were measured using a special Merck test kit, and samples were conserved for future laboratory work.

2.3 Methane determinations in lake sediments and permafrost

Immediately after the core recovery, samples from the lake and permafrost sediments were taken, weighed, placed in glass vessels, sealed by air-tight plugs, and degassed during 4 hours. Gas samples for analysis were drown through the butyl rubber stopper using a 1 ml syringe. Methane concentrations were analysed in the field using the portable gas chromatograph XPM-4 (Chromatograph Co., Russia) equipped with a flame ionisation detector and 2 m long stainless steel column filled with Porapac Q resin.

2.4 Methane emission measurements

The methane flux from the lake shore sediments was determined using static chambers. The chambers were made of thin stainless steel sheet and comprised of two blocks: a constant base, which was inserted into the sediment and a 400x400x250 mm chamber. The base was edged along its periphery by a channel filled with the lake water, and the chamber was installed in it. The system provided for air tight connection between the base and the chamber and prevented sediment destruction by the repeated measurements on the site. Each chamber had a cover with a hole fitted with butyl rubber stopper, to which fine steel needle was attached. Each needle was supplied by a thin 1 m long polypropylene tube with a cock at its tip. This setup reduced the mechanical impact on the chamber at the time of sampling.

The first gas sample was taken from the chamber immediately after its installation. Sampling intervals were 30 minutes during 2 consecutive hours. Gas samples were taken using a 10 ml polypropylene syringe with a cock and than were transferred into 5 ml glass vacutainers for future chromatographic analysis which was conducted usually at the day of sampling. Gas fluxes were calculated taking into account the increment of methane concentrations under the chamber in time, its area and volume.

2.5 Determination of methane production and oxidation rates

To determine microbial methane production and oxidation rates small subcores (5 ml in volume) of the lake sediments were taken from different horizons of the sediment cores in the field using Hungate glass tubes with a cuted tip. Butyl rubber plungers were than inserted in the tubes through the cuted side, sediment samples were moved by the plungers to the opposite side of the tubes and closed with butyl rubber disks and screw cups.

For the determination of the microbiological methane generation rate 100 μl of ^{14}C labelled substrates ($NaH^{14}CO_3$ and $^{14}CH_3COONa$, 0.37 MBq) were injected in the sediment subcores through rubber disks by a 1 ml syringe. The tubes were exposed at the "in situ" temperatures in dark for 72 hours. Experiments for the determination of methane oxidation rates were conducted in the same way injecting 100 μl water with ^{14}C-methane (0.037 MBq) dissolved in it. The experiments were terminated by the injection of 5 ml of 1 M NaOH solution in each tube. The further processing of the samples in the radioisotopic laboratory at the ISSP in Pushchino is in progress.

3 PRELIMINARY RESULTS AND DISCUSSION

3.1 Temperature regime of the lake and permafrost sediments

The temperature profiles of the sediments in the drained part of the lake bottom and peat soils in polygonal bog on alas surface are presented in Fig. 3. The thickness of the seasonally thawed layer, in which active biogeochemical processes could be possible, amounted to 100 cm in the sediments. This is 2 times higher than active soil layer of peat cryosols in polygonal bogs on the Holocene alas surface. The temperature of frozen lake sediments determined in the bore hole (C 1) in the layer of annual temperature fluctuations was -8.1°C. This value is quite the same as in the alas sediments (-8.3°C) measured in the bore hole drilled by Dr. GILICHINSKY in 1993 in a Holocene thermokarst depression near the confluence of B. and M. Kon'kovaya rivers.

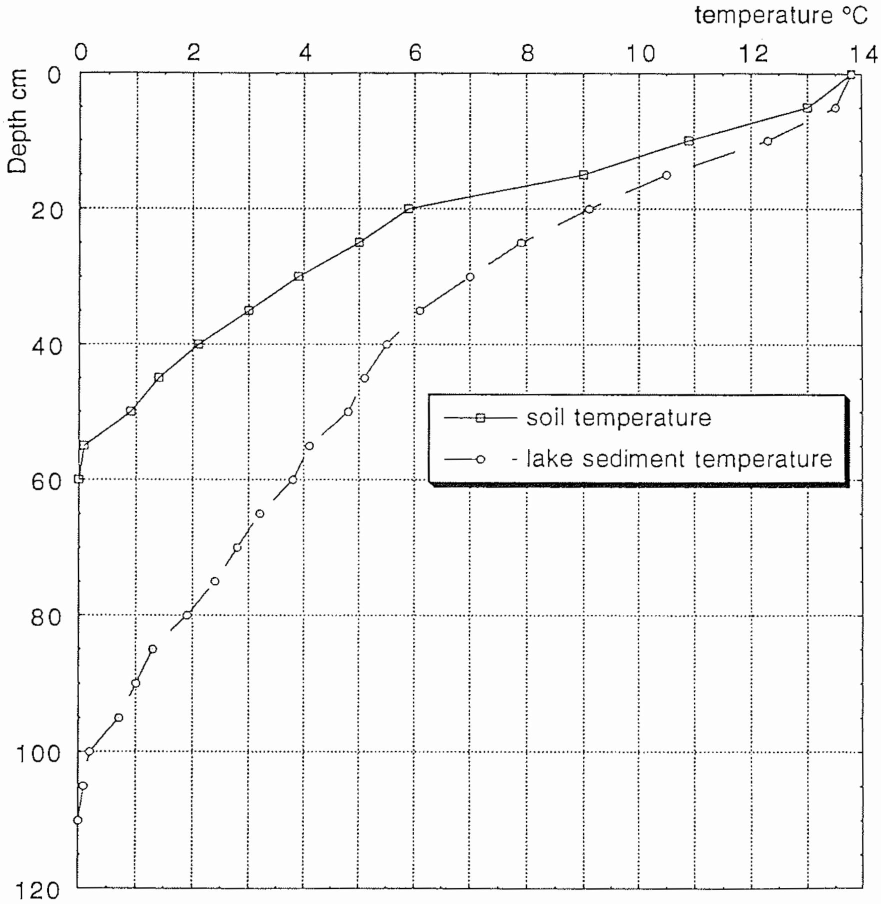


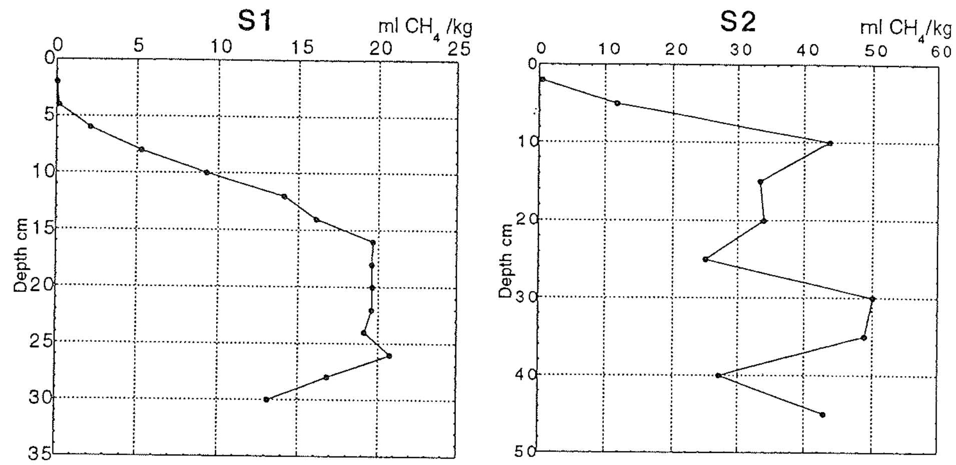
Fig. 3: The temperature profile in near-shore lake sediments and in the active layer of cryosols on the alas surface

This temperature is almost 2°C higher in comparison with this one in Edomic sediments of this area (-10.1°C). It is caused by the warming influence of thick snow cover in the depressions. The accordance of annual temperatures of frozen modern sediments below the lake bottom drained at the moment and Holocene alas sediments confirms that the heating effect of the lake waters was too low to form the talik zone here.

3.2 Methane content in the lake and permafrost sediments

Methane distribution and content in the lake sediment cores are shown in Figure 4 (S1, S2). The methane content in the modern sediments of the central part of the lake varied from 0.025 to 19.63 ml CH_4 per kg. In the near-shore sediments CH_4 concentrations are markedly higher and varied from 0.5 to 50 ml per kg. The decrease of CH_4 content in upper part of the sediment cores (S1, S2) indicates that aerobic methane oxidizing bacteria can be active in this layer. The increase of the methane content with depth is caused probably by the activity of methane generating bacteria. The laboratory treatment of field experiments to determine biogeochemical activity of these two microbial groups in the modern lake sediments is in progress.

The methane content in frozen sediments varied with depth (Fig. 4, C1). It seems to be possible to differentiate the data in 3 groups: modern (post-Holocene) sediments from the surface to 3.15 m depth with CH_4 contents from 0.52 to 14.5 ml per kg; Holocene taberal sediments contain between 0.33 and 6.4 ml CH_4 per kg; Olerian sediments have high methane contents ranging from 5.8 to 18.1 ml per kg. New results obtained in this study confirm our previous data that only sediments saturated with water at their formation contain methane (SAMARKIN et al., 1994).



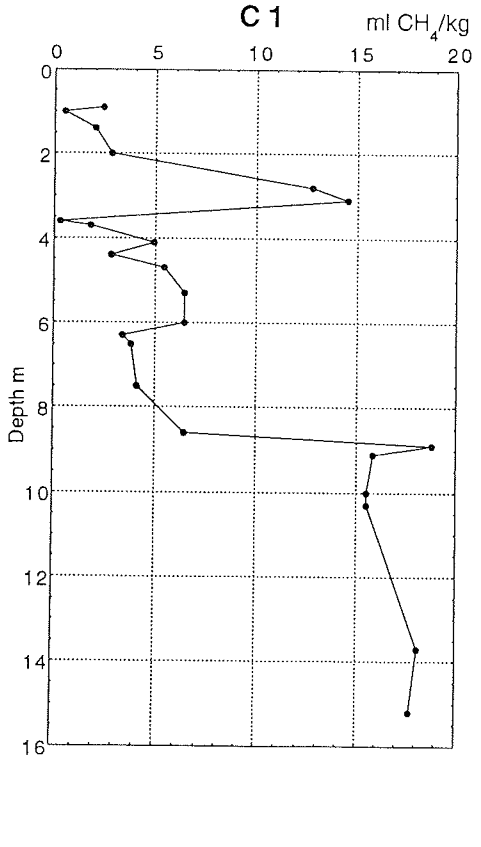


Fig. 4: Methane content in the B. Oler Lake sediments

S1 - modern sediments from the lake centre
S2 - near-shore sediments
C1 - permafrost sediments from the borehole

3.3 Methane flux from the lake sediments

Methane emission from near-shore lake sediments was studied on 6 sites with different water table positions. The CH_4 flux was low at the sites with a water table below the sediment surface on which it varied from 0 to 7.5 mg CH_4 per square meter per day with a mean value of 3.7 (6 measurements). It was markedly higher at the sites with water table position on the sediment surface and up to 5 cm above it and varied from 12.9 to 39.4 mg m^{-2} day^{-1} with a mean value of 21.1 mg CH_4 per square meter per day (6 measurements).The maximal fluxes (77.9 and 255.6 mg CH_4 m^{-2} day^{-1}) were registered at the site located in a small 5 cm deep pool on the drained sediment surface. Furthermore, gas bubbling was observed periodically in different parts of near-shore lake zone.

4.4 CONCLUSIONS

The study of CH_4 emissions from the drained and near-shore lake sediments shows that they represent a marked methane source in the tundra.

Frozen lake sediments contain sufficiently large amounts of methane. Increase of sediment thawing caused by possible climate warming can involve this "passive" methane reserve into the active biogeochemical cycle and increases the CH_4 emission from tundra lakes to the atmosphere.

The methane distribution in frozen sediments indicates no significant gas transport after their deposition. Hence, this parameter can be useful for the reconstruction of the paleoenvironmental conditions of sedimentation, dia- and epigenetic processes in lakes and permafrost.