Russian-German Cooperation: The Expedition TAYMYR 1994

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with contributions of the participants

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This volume is dedicated to the memory of
Stanislav F. Khrutsky
(1937 - 1995)

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1. INTRODUCTION

As the northernmost region of the Eurasian continent, the Taymyr Peninsula is a particularly interesting region of the Arctic (Figure 1.1). Together with the Severnaya Zemlya archipelago, it covers the entire spectrum of arctic landscapes from the northern boreal forest and forest tundra across the typical tundra to the northern arctic desert, including the high altitude mountain regions. Alternate interglacial periods with marine transgressions and glacial periods with continental glacial and periglacial processes influenced the Quaternary environmental history of the region. The course of these events was especially complicated by a transitional climate between those of east and west Siberia. As yet, no generally recognized scenario for the region's last Pleistocene glaciation exists. There is a lack of information concerning its periglacial development (Velichko, 1993). Well-founded proposals for the paleogeography of the Taymyr-Severnaya Zemlya region are particularly important because they provide important premises for the reconstruction of the Late Quaternary environmental history of the "Laptev Sea System".

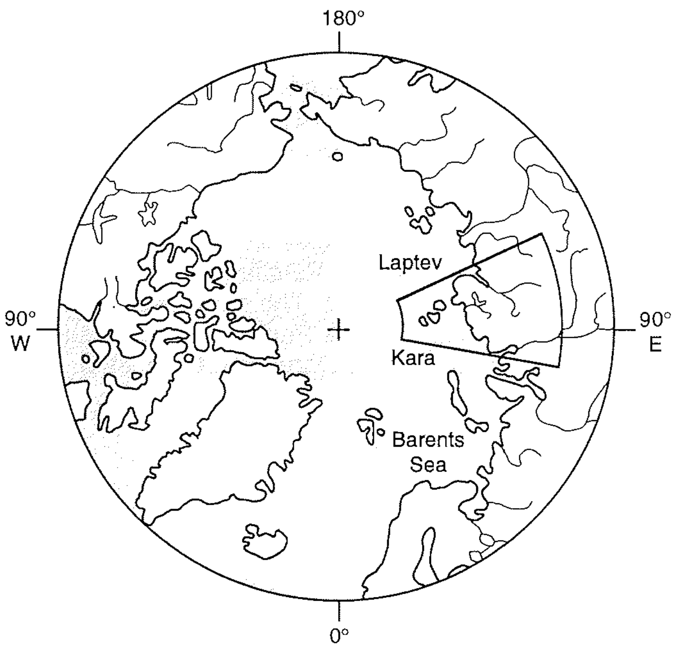


Figure 1.1: Map showing the location of the Taymyr Peninsula and Severnaya Zemlya Archipelago (encircled)

To address these issues, the German-Russian research project "Late Quaternary Environmental Development of Middle Siberia" was created in 1993. Its goal is to use lake sediment records and syngenetic permafrost records of the area to propose solutions for the above-mentioned problems. The investigations are to be carried out along a South-North transect from the region surrounding Norilsk, over the Taymyr Peninsula, to the Severnaya Zemlya Archipelago (Figure 1.2).

The 1994 Taymyr Expedition was a part of this project. Its multi-disciplinary program is intended to provide information concerning the processes at work in the "Permafrost-soil-hydrosphere-biosphere" system, and thus to contribute to an understanding of the peculiarities of and changes in these processes in the Late Quaternary. The results will also contribute to an understanding of sedimentary and permafrost processes with respect to global change.

Field work in 1994 concentrated on geocryological and hydrological investigations. Two different regions were chosen as study sites (Figure 1.2). One group of researchers investigated water and sediment transport in permafrost landscapes at Levinson-Lessing Lake (Byrranga Mountains). In preparation for the 1995 field season many instruments were installed in active layer profiles. Studies of Quarternary geology, geomorphology and landscape ecology initiated in previous years by members of the Russian Arctic and Antarctic Research Institute (AARI) were continued.

The second group completed an extensive paleogeographic-geocryological study in the Labaz Lake region (in the eastern part of the Taymyr Lowlands). The study was complemented by pedological and microbiological investigations of recent Tundra soils.

The concrete expedition plans were made in January and February, 1994, during visits by scientists from AARI to Potsdam, and during further planning sessions in Moscow and St. Petersburg. The experiences and data collected by the 1993 pilot study on the Taymyr Peninsula and in the Norilsk region proved to be an important basis for the planning (Melles et al., 1994).

1.1 Itinerary

C. Siegert

The German participants flew on July 11, 1994 from Berlin to St. Petersburg. The greater portion of the expedition's equipment had been previously sent by ship from Bremerhaven to St. Petersburg, excepting a number of sensitive instruments that were transported as hand luggage. The expedition members from Moscow travelled by train on July 12, 1994, taking their equipment also by train. Control of logistic operations in St. Petersburg was assumed by members of AARI.

Further transport of the expedition participants and all equipment occurred on July 18, 1994, via charter flight from St. Petersburg to Khatanga, with fuelling

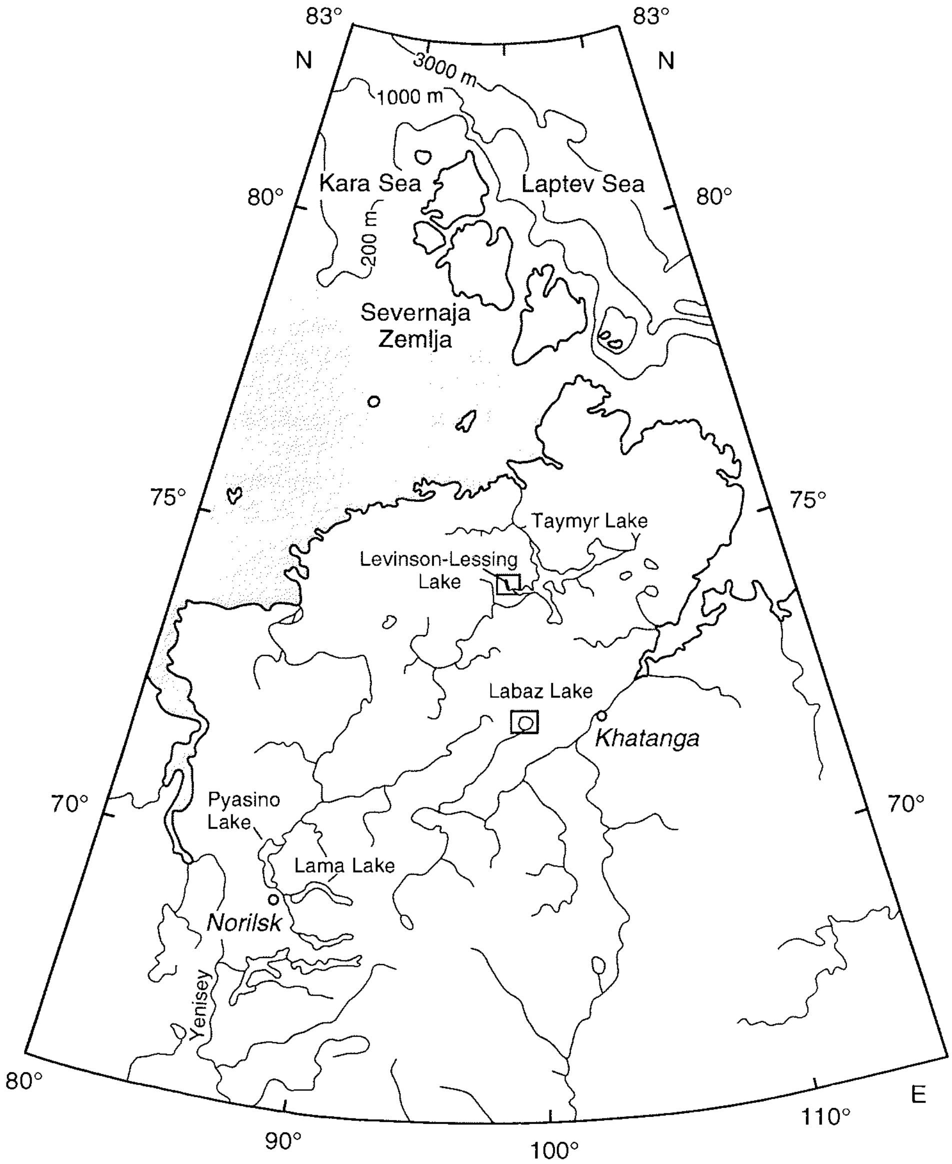


Figure 1.2: Map showing the Taymyr region with the two research areas around Levinson-Lessing Lake and Labaz Lake (encircled).

stops in Archangelsk and Amderma. The two field camps were reached by helicopter flights out of Khatanga on July 20 and 21.

The research group at Levinson-Lessing Lake worked out of a base camp already established by AARI scientists, who had begun field work in the second half of June. This work concentrated on collecting hydrologic data and measuring sediment transport into the lake during snowmelt. The second group, working at Labaz Lake, established their base camp with its own fully original "infrastructure", and began the research program on July 24, 1994.

Field work at both lakes was continued until the end of August. Between August 30 and September 2, both camps were flown back to Khatanga, first from Levinson-Lessing, and then Labaz. After a few day's delay in Khatanga expedition members and some equipment flew back to St. Petersburg in the by now familiar JAK-40. The balance of the equipment was returned via a charter flight of the Taymyr Nature Reserve administration. The time spent in Khatanga permitted the organization and storage of some of the Russian field equipment and other logistic operations, in addition to an excursion on the Khatanga River aboard a Hydrological service vessel.

It was possible to take care of customs formalities for a few specific instruments and some of the sample material in St. Petersburg within a relatively short time. On September 9, the German expedition participants returned to Berlin.

The expedition was completed essentially within the constraints of the schedule planned beforehand in cooperation with the Russian partners. Serious delays occurred only in clearing customs in St. Petersburg on the way to Siberia, requiring a postponing of the flight from St. Petersburg by 6 days. Part of the lost time was recovered through good organization, the charter flight and also the helicopter flights to the field camps. Of particular help was the cooperation between the expedition leaders and the administration of the Taymyr Nature Reserve in Khatanga.

Shipment of the expedition equipment and of the majority of samples from St. Petersburg to Bremerhaven followed on December 17, 1994 via the research vessel "Akademik Federov". The clearing of customs in St. Petersburg, accomplished by members of AARI, St. Petersburg, took longer than expected. Following analyses of sample materials and the evaluation of subsequent results occurs in close contact with our Russian partners.

1.2 Characteristic Features of the Research Areas

C. Siegert, D. Yu. Bolshiyanov

The research areas belong to different structural tectonic elements of the Taymyr-Severo Zemlya region, with diverse geomorphological developments in the Late Pleistocene and present period.

The Levinson-Lessing area of the Byrranga Paleozoic fold system is a region of dominant denudation on epigenetic frozen rocks. Intensive sediment accumulation occurs in the tectonically formed, deep limnologic basin (see chapter 2.1). The sediment can therefore be used as a paleogeographic data archive. It is also highly likely that recent denudation processes can be quantified through hydrological investigations. Syngenetic frozen Quaternary sediments are present in limited areas on the floors and under slopes of streamcut valleys and in the littoral zone of the lake. They also provide a limited source of information for the reconstruction of the environmental history of the area by studies of permafrost profiles.

The Labaz area is located in the Yenisej-Khatanga depression in a zone of Mesozoic subsidence. During the Late Pleistocene this region was an arena of sediment accumulation. Thick and very ice-rich permafrost, including syngenetic frozen sediments with buried cryosols, were formed. Since the Holocene, there has existed a quasi-equilibrium between the processes of accumulation and denudation of the syngenetic frozen substrate. Soil and ground ice formation and peat accumulation were of great importance. The Labaz Lake area is thus highly suitable for environmental history reconstruction through permafrost studies. The investigation of bottom sediments in selected lakes can also be carried out.

The main physio-geographical characteristics of the research areas have been compiled and are presented in Table 1.2. Figure 1.3 shows the fluctuation of average air temperature in the research areas and at the Taymyr meteorological station in summer 1994 and demonstrates the specific microclimatic features of the central territories of the Taymyr Peninsula.

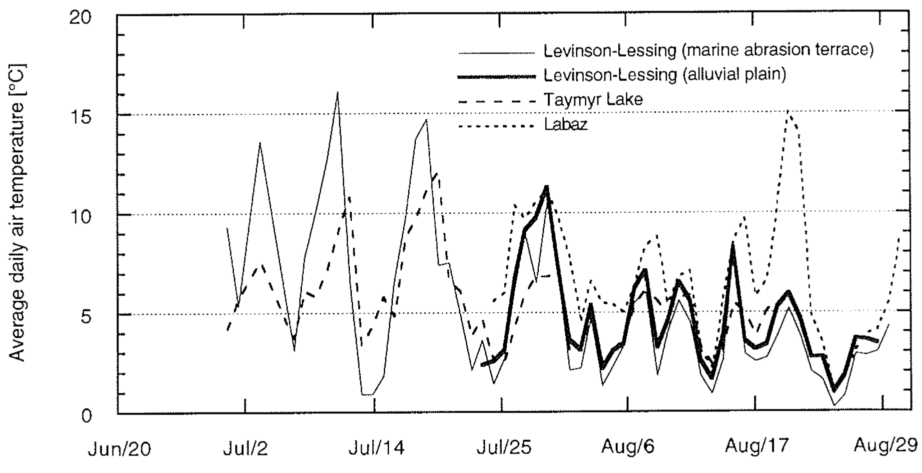


Figure 1.3: Average air temperature in summer months 1995 measured at the research areas and at the Taymyr Lake meteorological station.

Table 3.1 Physical geographical characteristics of the research areas *

Physical geographical characteristics	Labaz Lake region	Levinson-Lessing Lake region
Botanical geographical zone	Boundary zone between southern and typical (northern) tundra	Typical tundra
Mean air temperature	-13,4°C	-, 14,5°C
Mean temperature /January	-33,8°C	- 33,1°C
Mean temperature /July	+12,3°C	+6,5°C
Frost free period	73 days	50 days
Precipitation/year	237 mm	283 mm
Permafrost thickness	400 m	500-700 m
Mean rock temperature on the depth of zero annual amplitude	-7 to -9°C	-9 to -11°C
Mean active layer thickness	0,20 to 0,50 m	0,80 to 1,0 m
Relief	Flat land with altitudes up to ~150 m above sea level	Low mountain region (up to 560 m) with ancient and modern networks of erosion valleys
Hydrology	Territory with a large number of lakes and swamplands strongly regulating the river runoff	Mountain rivers with large contents of suspended material, deep mountain lakes, very short (≤75 days) active hydrological regime

* Data from: Adamenko & Egorov, 1985; Atlas Arctici, 1985; Ershov, 1989; Vasilevskaya, 1980. Climatic data for the Labaz Lake region from the Khatanga meteorological station , for the Levinson-Lessing Lake from the Taymyr Lake meteorological station.

2. INVESTIGATIONS IN THE LEVINSON-LESSING LAKE AREA

2.1 Geomorphological Studies and Landscape Mapping

D.Yu. Bolshiyanov and M.A. Anisimov

The following ongoing projects were continued during the 1994 field season:

- Geomorphological and landscape mapping of the Levinson-Lessing drainage area was carried out on a scale of 1:100 000. The drainage basin, with an area of 430 square kilometers, was covered by a network of surveying routes with a total length of 300 km and 240 stations (Figure 2.1).
- Specific mapping of the Krasnaya river flood plain using the theodolite was carried out to investigate the dynamic of fluvial processes during different stages of the river's hydrological regime.
- Solifluction profiles on slopes of 2 and 6 degrees incline were laid out to investigate the intensity of slope processes and to calculate the volume of sediments thus transported to the lake.
- Additional measurements of lake depth were carried out along numer ous profiles (Figure 2.2, 2.3).

The investigated area is a part of the Byrranga folded zone. Its geomorphological construction is relatively uncomplicated. Low mountain relief (up to 569 m) has developed in the Permian terrigenic rocks with intrusions of dolerites. The main relief form of the mapping area was an ancient valley of complex denudation with a depth up to 600 m and width up to 9 km. The slopes of the valley were complicated by deeply downcut valleys and marine and denudational terraces. The presence of marine sediments – sands and bench gravels – at altitudes of up to 200 m, and abrasion terraces at altitudes of 250-300 m, evidence repeated marine transgressions into the valleys of the Central Taymyr region. The most recent transgression occurred in the Late Pleistocene. Sampling and the study of Quaternary deposits from some of the natural exposures, as well as ESR (electron-speen-resonance spectroscopy) datings of these sediments will yield an opportunity to determine the time of existence of marine basins and another paleogeographical events.

An analysis of the Levinson-Lessing Lake basin and lineaments of the mapping area show that this territory consists of many crustal blocks, which are divided by numerous faults. The Levinson-Lessing depression is a result of tectonic movements of the crust in blocks.

The most important exogenic process in the formation of relief is erosion. Young, deeply downcut valleys with a cross-sectional V-form are evidence of periods of intensive erosional cutting. The very small catchment areas of the corresponding streams, as well as their deep valleys, are evidence of existing widespread but thin fields of snow and glaciers at the tops of the watersheds. Another source of water for erosion could not have existed. The role of glaciers and snowfields in relief construction was the production of large volumes of water during glacial regression periods. The last such stage which

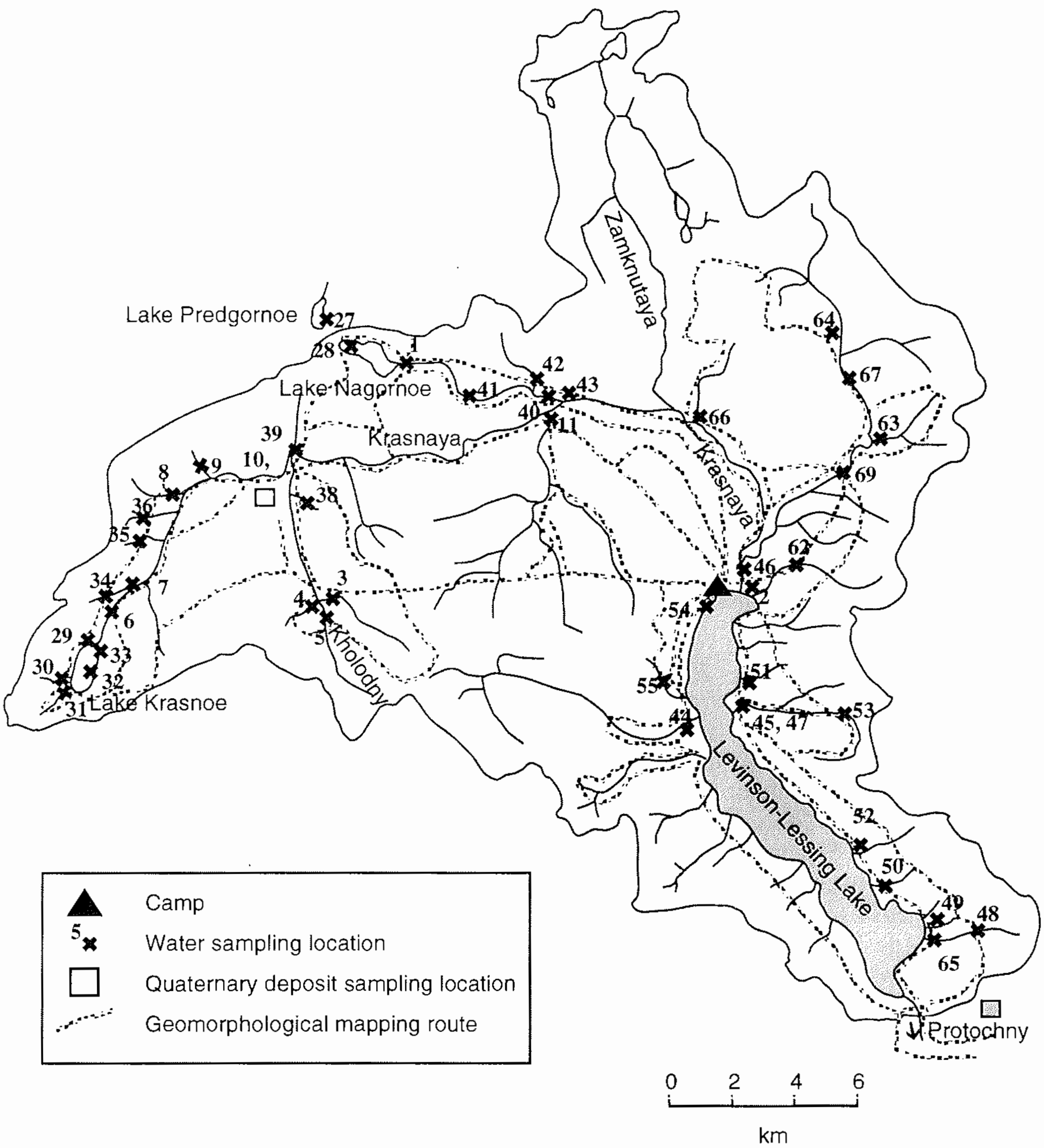


Figure 2.1: Hydrological and geomorphological investigations carried out in the Levinson-Lessing watershed

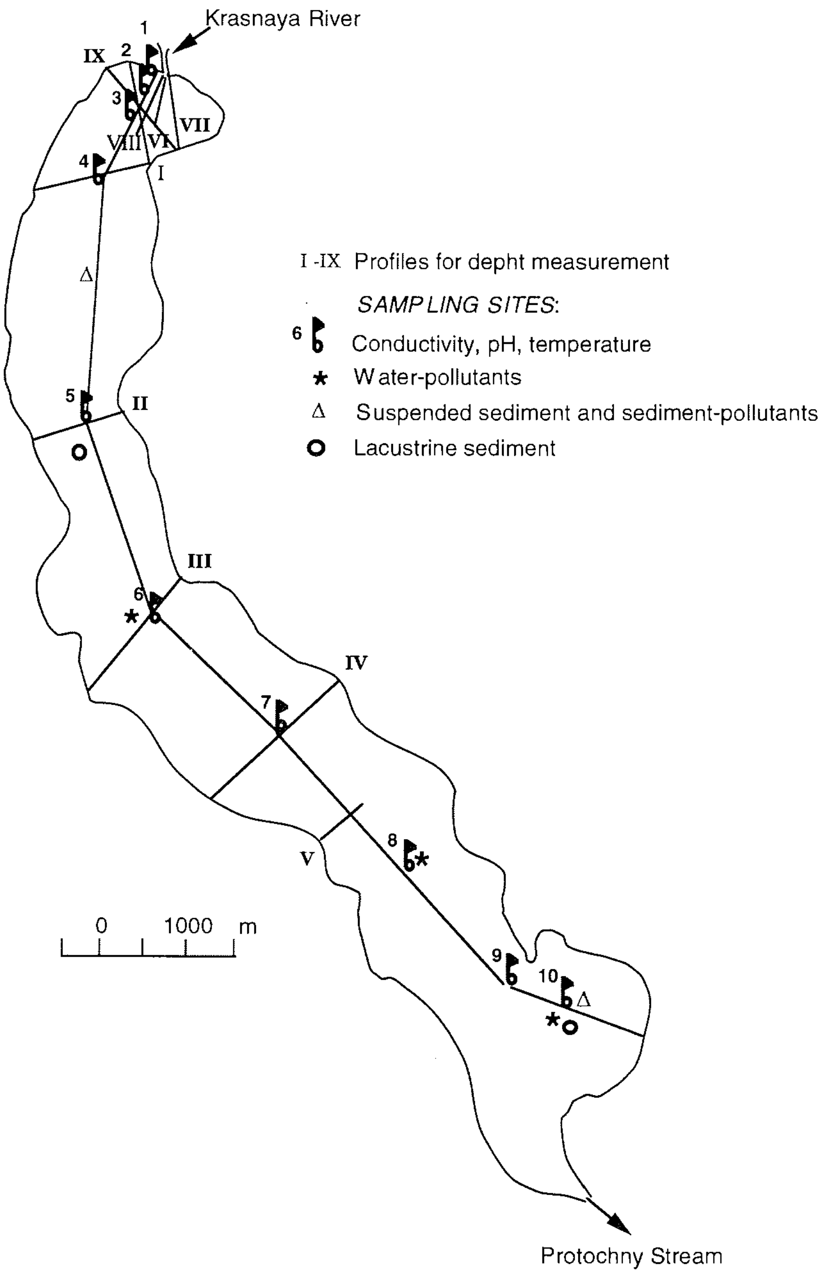


Figure 2.2: Sampling sites and profiles for depth measurements in the Levinson-Lessing Lake

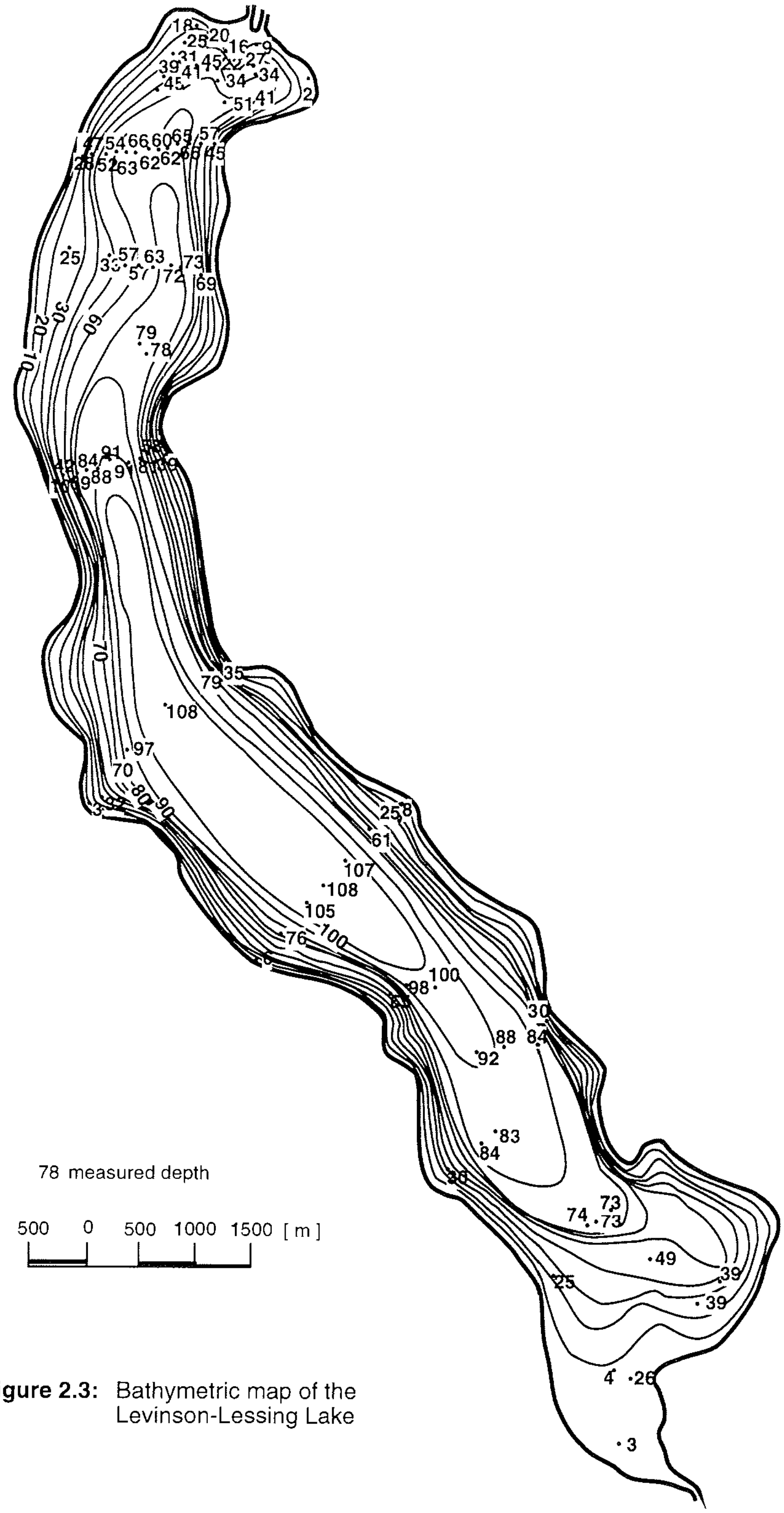


Figure 2.3: Bathymetric map of the Levinson-Lessing Lake

was important for relief construction, occurred after 9 000-8 000 years B.P. (the radiocarbon age of peat found on the first terrace of the Krasnaya River, which was replaced by vast alluvial or glaciofluvial fans from the eastern and western slopes of Levinson-Lessing basin). There exists no evidence for glacial erosion in the mapping area.

As a result of geomorphological investigations and initial studies of bottom lake sediments (including some cores up to 1.4 m length), we can confirm that the tectonic origin of Levinson-Lessing Lake makes it a unique reservoir of paleogeographical information recorded in bottom sediments accumulated continuously over a period of some tens of thousands of years.

2.2 Hydrological Studies

Hydrological activity was directed to calculate the balance of water and sediments flowing into and out of Levinson-Lessing Lake and to investigate processes of sedimentation in the lake as well. For these purposes numerous investigations were carried out :

- measurements of meteorological data at two stations installed on the first terrace and on the floodplain of the Levinson-Lessing Lake;
- organization of two water measuring points in the inflowing river (Krasnaya River) and outflowing stream (Protochnyi Stream);
- measurements of water level in two main streams and in the lake;
- measurements of water velocity in streams;
- sampling of suspended sediments under different hydrometeorological installation of instruments on a variety of slopes surrounding the lake to investigate processes of water migration in the active layer.

2.2.1 Surface Drainage

D.Yu. Bolshiyanov, D. Gintz, V.P. Zimichev

Data have been obtained concerning water regimes and suspended load in the Krasnaya River and Protochnyi Stream during spring high water and summer low water periods.

Daily oscillations of water discharge are recorded for the Krasnaya River (Figure 2.4). They depend on fluctuations of the air temperature in the basin of the Krasnaya River. The amplitude of daily oscillations is nearly ten centimeters. In the Protochnyi Stream such oscillation are absent due to the regulational role of Levinson-Lessing Lake (Figure 2.5).

The dependence of water discharges on the level dynamic have been determined as a result of measurements in the hydrological profiles (Figure 2.6). The calculation of the total volume of water drainage in investigated streams show that the total volume drained by the Krasnaya River is only 40 - 50 % of that of the Protochnyi Stream (Figure 2.7).

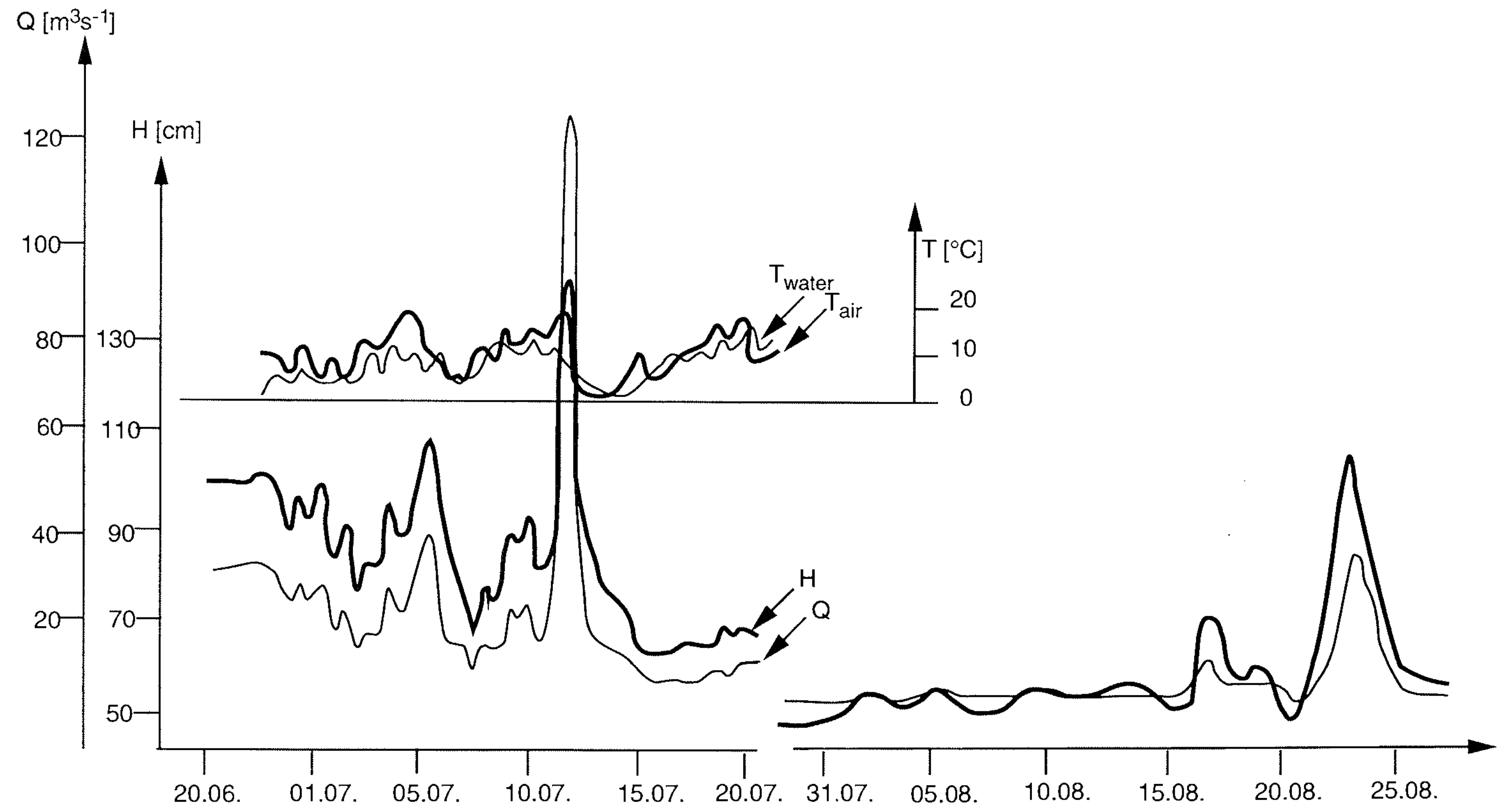


Figure 2.4: Variation of water level, discharge and temperature of the Krasnaya River and air temperature during the observation period

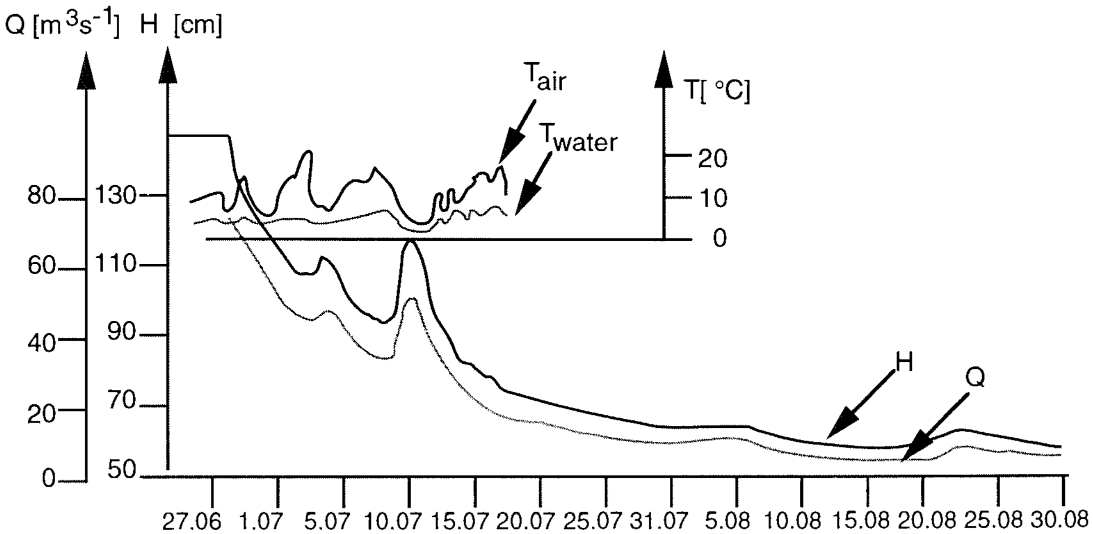


Figure 2.5: Variation of water level, discharge and temperature of the Protochny Stream and air temperature during the observation period.

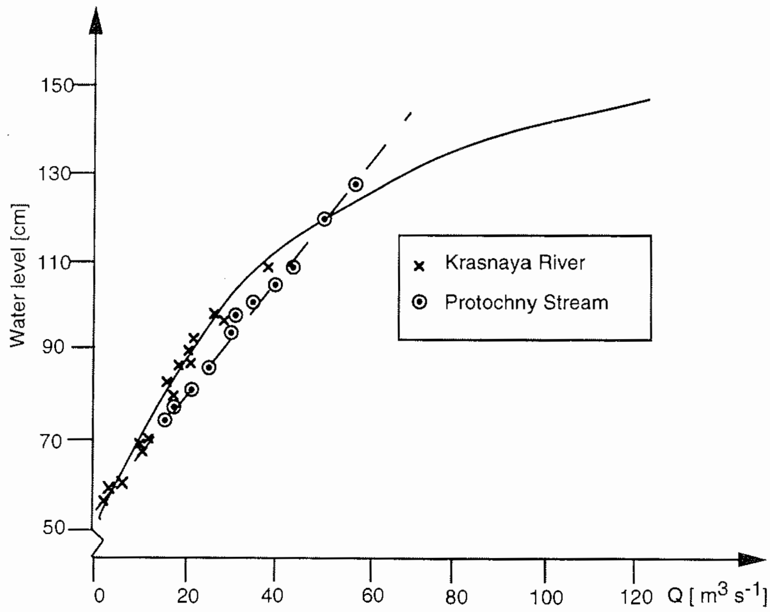


Figure 2.6: Relationship of water level and water discharge in the Krasnaya River and Protochny Stream

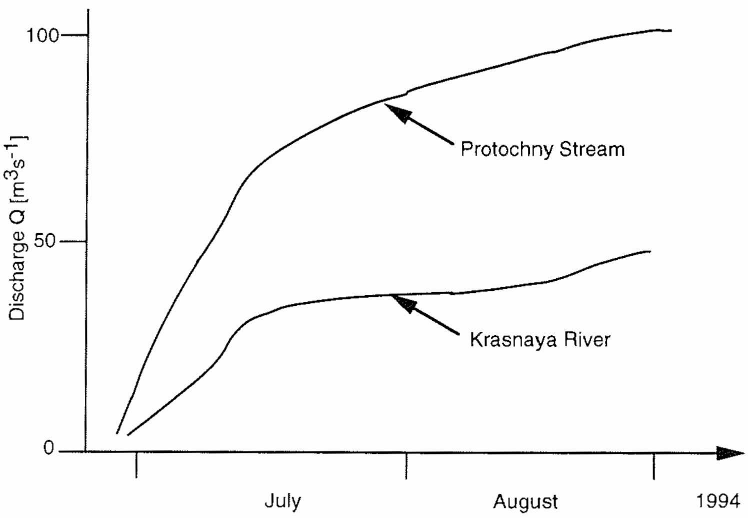


Figure 2.7: Water discharge of the Krasnaya River and Protochny Stream

Fluctuations of the suspended sediment load in the Krasnaya River are presented in Figure 2.8. The suspended sediment concentration of the river water varies over a wide range and depends on the phase of the hydrological regime of the river-lake system. Maximum suspended sediment load was recorded during freshets, which are the result of periods of intensive rain. During such periods, the river's sediment transport reaches levels equal to an entire decade of transport at normal regime levels. At the observed cross profile for this special event, the sediment load which passed through in one day (12.07.1994) was 20 times more than in the total remaining observation period. The total input of sediments discharged into Levinson-Lessing Lake during the time of observation was 10 500 tonne. The freshet event of 12.07.1994 accounts for 95% of this weight. The total suspended sediment output through the Protochnyi Stream over the period of observation was 300 - 500 tonne.

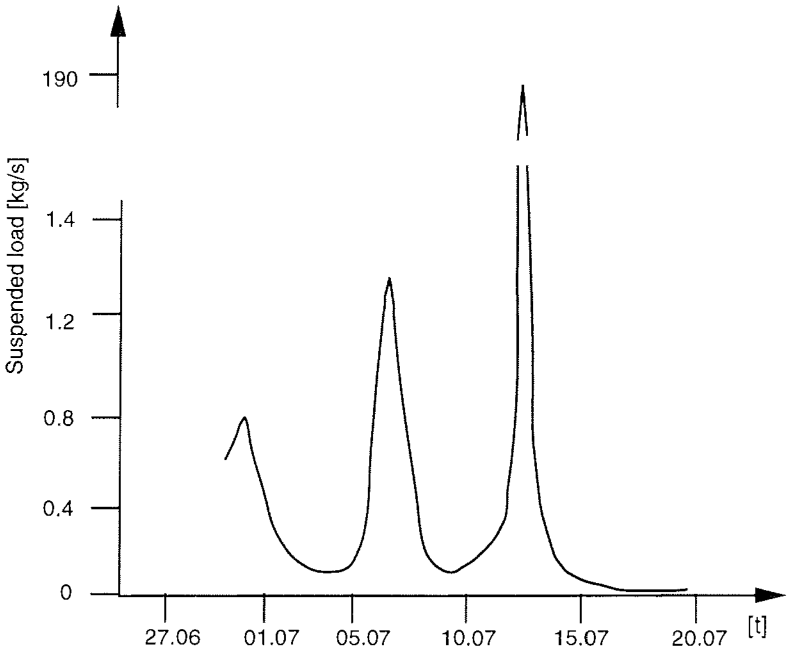


Figure 2.8: Fluctuation of the suspended load in the Krasnaya River

2.2.2 Hydrological Processes in the Levinson-Lessing Lake

D.Yu. Bolshiyanov, D. Gintz, V.P. Zimichev

The horizontal and vertical suspended sediment concentration distribution through the lake was irregular and depended on numerous factors. The turbidity of water was not always maximal in the northern part of the lake, where the main stream inflows. Apparently, 20 little streams from the other slopes of lake basin are important for the distribution of suspended sediments in the lake, but their influence is negligible when compared to the transport of sediments through the Krasnaya River. In the biggest stream the water discharge was 2.5 $m^3 s^{-1}$; the suspended sediment yield was 0.13 kg s^{-1} during the freshet of 22.08.1994. After one or two days of intensive drainage, such streams usually dry up.

During storms, the turbidity of surface water in the shallow, southern part of the lake is higher than usual. High concentrations of suspended particles near the bottom in the northern part of the lake in comparison to surface layers of water show that water masses of the Krasnaya River enter the lake along the slope of the alluvial cone, through the lower water layers.

Some measured hydrochemical parameters of the lake water are not constant and are under the influence of inflowing water. As a whole, conductivity and the pH of the lake water are more constant in the northern and in the southern parts of the lake. The concentration of total dissolved solids fluctuates from 7 to 15 mg per liter. In the mouth of the Krasnaya River and in the northern half of the lake it lies between 7 and 37 mg l^{-1}, depending on fluctuations in stream drainage; the streams flow through massives of carbonated rocks on the eastern and northeastern slopes before entering the lake. The pH of the water lay between from 6.16 and 6.88 with an average of 6.50 (Table 2.1). Stream water dissolved solid concentrations in the lake basin depended on the geoogical composition of the corresponding catchment area and fluctuated from 0.2 to 121 mg l^{-1}. Observations of water level oscillations, which were benchmarked, have shown that they depend on the upstream hydrological regime of the inflowing river (Figure 2.9).

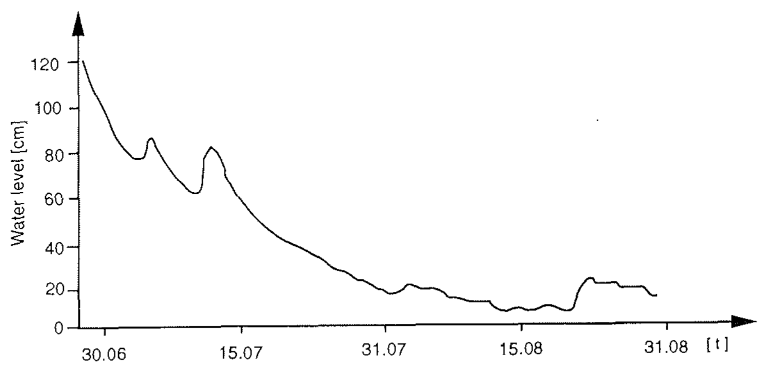


Figure 2.9.: Water level fluctuation of the Levinson-Lessing Lake ("0" is 3.395 m under the AARI bench mark)

Table 2.1: Hydrochemical charcteristics of Levinson-Lessing Lake water samples

Date	Sample No	Sampling point, depht[m]	pH	conductivity µS/cm	mineralization mg/l
		hydrological station (hs) No 4			
4.08.94	12	61,5	6,63	53,2	36
4.08.94	13	50,0	6,90	53,8	37
4.08.94	14	0,0	6,82	53,9	37
4.08.94	15	10,0	6,83	53,6	37
4.08.94	16	0,0	6,77	53,9	37
		hs No 5			
5.08.94	17	88,0	6,39	53,4	36
5.08.94	18	10,0	6,24	53,5	37
		hs No 6			
10.08.94	19	106,0	6,68	49,9	14
10.08.94	20	10,0	6,68	49,7	15
10.08.94	21	0,0	6,74	49,9	15
		hs No 5			
10.08.94	22	10,0	6,64	9	14
10.08.94	23	0,0	6,56	29	13
		hs No 3			
10.08.94	24	54,0	6,46	50,8	14
10.08.94	25	10,0	6,39	32	14
10.08.94	26	0,0	6,45	52,8	6
		hs No 5			
17.08.94	20	90,0	6,95	44,5	9
17.08.94	21	10,0	6,92	44,4	10
17.08.94	22	0,0	6,91	45,1	11
		hs No 4			
17.08.94	73	61,0	6,93	45,1	12
17.08.94	74	10,0	6,86	45	12
17.08.94	75	0,0	6,88	45,2	13
		hs No 2			
17.08.94	76	42,0	6,	45,8	14
17.08.94	77	10,0	6,95	3,9	14
17.08.94	78	0,0	6,9	42,2	13
		hs No 10			
25.08.94	56	51,0	6,16	50,9	11
25.08.94	57	0,0	6,87	51,7	6
		hs No 6			
25.08.94	58	80,0	6,88	51,9	6
25.08.94	59	0,0	6,84	52,8	11
		hs No 3			
25.08.94	60	50,0	6,88	54,2	7
25.o8.94	61	0,0	6,83	52,2	7

2.2.3 Active Layer Hydrology: Seasonal Transport of Solutes in the Active Layer

J. Boike, P. P. Overduin, D. A. Gintz and M. A. Anisimov

2.2.3.1 Introduction

In arctic regions, hydrological and geochemical processes are directly controlled by the presence of permafrost – "ground (soil or rock) that remains at or below 0°C for at least two years" and the seasonal thawing of the active layer " the top layer of ground subject to annual thawing and freezing in areas underlain by permafrost" (Glossary of Permafrost, 1988). Most of the processes occur during the short summer season from May to August and cease during the winter. The typical high arctic-nival streamflow regime is characterized by high discharge rates during snowmelt and rainstorms due to the limited infiltration and storage capacity of the ground. As the active layer thaws with progress of the summer, the infiltration and storage capacity of the ground are increased. Consequently, geochemical and hydrological activities in the active layer are enhanced and influence the hydrology and geochemistry of surface and groundwaters. Factors determining the water content of the active layer are the following: hydraulic conductivity of the soil, hydrological inputs (snowmelt, rainfall), evaporation and the thermal characteristics of the active layer. The thickness and extent of the phreatic zone above the frost table and within the active layer (called suprapermafrost groundwater) is highly dependent on the source of water and microtopography of the frozen ground.

Deficiencies exist in the scientific knowledge regarding the processes determining flowpaths and chemical behaviour of water through the active layer. Studies of hydrological and geochemical properties of frozen ground have been predominantly laboratory studies which focused on the migration of moisture and ions during the freeze-thaw process (eg. Loon, 1991). To date, no continuous, seasonal *in situ* research on water and solute transport within the active layer has been undertaken.
An understanding of active layer processes is necessary to determine chemical and hydrological fluxes within a lake catchment, for example, to quantify the importance of suprapermafrost groundwater input in a high Arctic lake water balance. Furthermore, information on transport processes in the active layer is fundamental to the understanding of the movement and chemical behaviour of contaminants in arctic ecosystems.

2.2.3..2 Study Objectives

The hypothesis of this research is that the seasonal freezing and thawing of the active layer has a major influence on the migration and chemical behaviour of solutes. The study investigates seasonal flowpaths in the phreatic and vadose zone of the active layer using physical methods for the determination of water masses and stable isotopes ($\delta^{18}O$, δ D) and radionuclides (^{3}H) as natural tracers for the determination of water sources, mixing rates and residence times. Since geochemical and hydrological fluxes are dependent on gradients and physical and chemical properties of the medium, analysis of active layer characteristics and climatic parameters are also undertaken.

With these objectives in mind, the main goal of the expedition in 1994 was to install instruments in the active layer during maximum thaw depth in order to start measurements in the frozen soil in spring 1995.

2.2.3.3 Field Work and Methods

Levinson-Lessing Lake is situated approximately 50 km west of the Taymyr Lake in the Byrranga Mountain range (Figure 1.2). A varying topography (slopes and flat areas) and typical tundra vegetation with charcteristics of arctic tundra enable a study of transport processes under different geological and geomorphological conditions. Three slopes with a sum of 16 sites were instrumented during the summer in the Levinson-Lessing Lake catchment (Figure 2.10). These slopes differ in: slope aspect and inclination, parent material, vegetation and thaw depth of the active layer. At each site, triple wire Time Domain Reflectometry (TDR) probes, PT 100 temperature probes, wells, piezometers and suction lysimeters were installed (Figure 2.11). Table 2.2 gives an overview of the installation depths of all instruments. During installation, disturbed and undisturbed soil samples were taken from each horizon for the analysis of pF curves, bulk density, porosity, grain size distribution and organic content. After installation, the following parameters were measured daily: volumetric moisture content and bulk electrical conductivity using TDR, water level in wells and piezometers, electrical conductivity and pH of ground and soil waters. Depth of thaw of the active layer was recorded at least once a week. Ground water samples were collected from wells and piezometers using PVC tubing and plastic syringes and from the vadose zone using suction lysimeters. Precipitation was sampled after each event. At least two samples (each 30 ml) were taken: one was analyzed for pH and electrical conductivity in the field; the second one was kept cool for stable isotope and radionuclide analysis in Germany. One permafrost core was drilled to a depth of 80 cm (below depth of thaw) and sectioned at 10-20 cm intervals. Water was extracted and is being analyzed for stable isotopes and tritium. A list of water samples collected during the field season 1994 is given in the Appendix: 7.1.

2.2.3.4 Future Work 1995

In 1995, data will be collected from May to October for one seasonal cycle of active layer freezing and thawing. This includes monitoring of the following processes:

- infiltration and interaction of snowmelt water with the frozen ground during springmelt;
- ion and water migration in the active layer during the seasonal thawing;
- development of the saturated zone (suprapermafrost groundwater) in the active layer;
- lateral solute transport in the active layer, lake-land linkages;

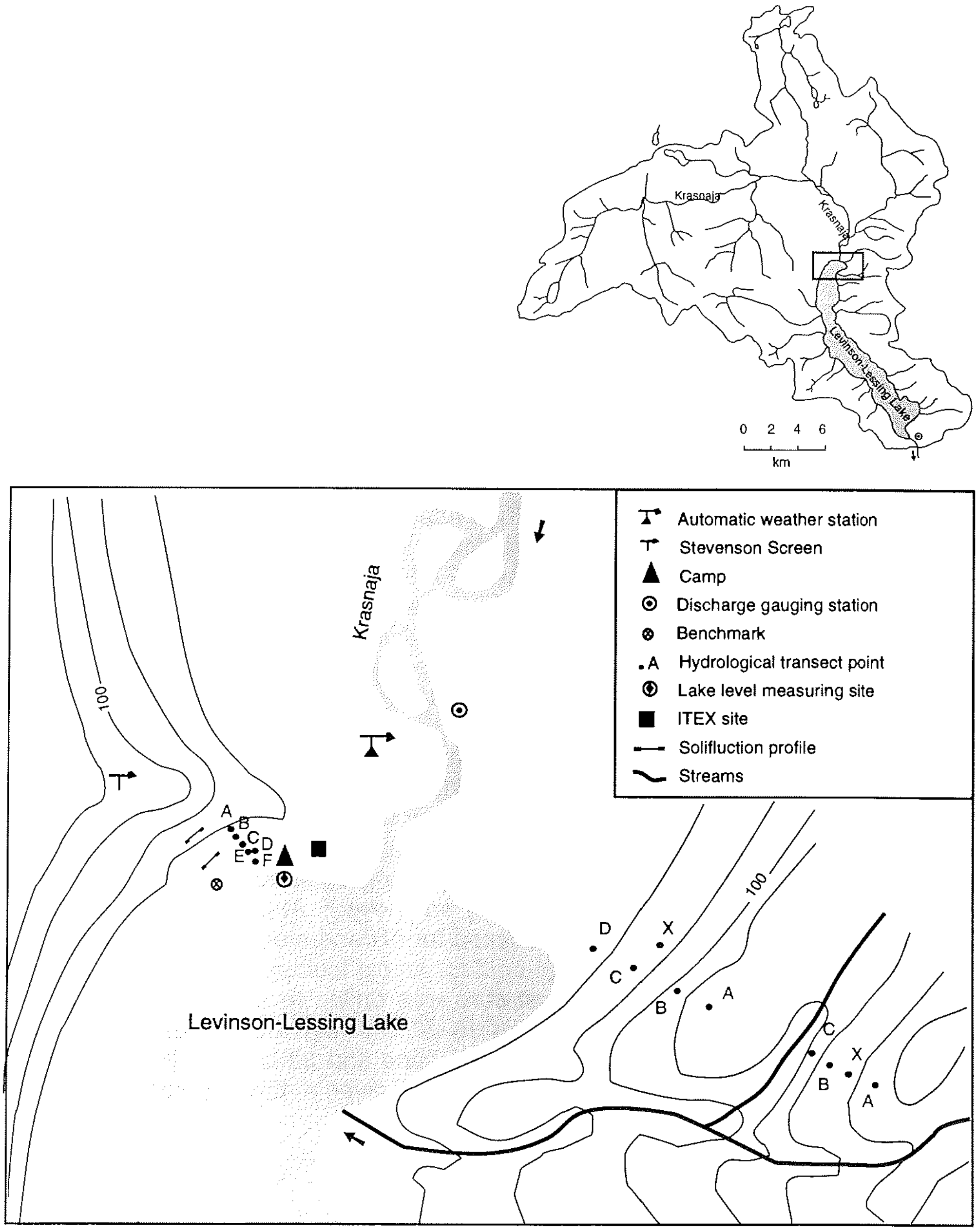


Figure 2.10: Detailed map of the intensive study area. The box marks the position of the area in the Levinson-Lessing basin.

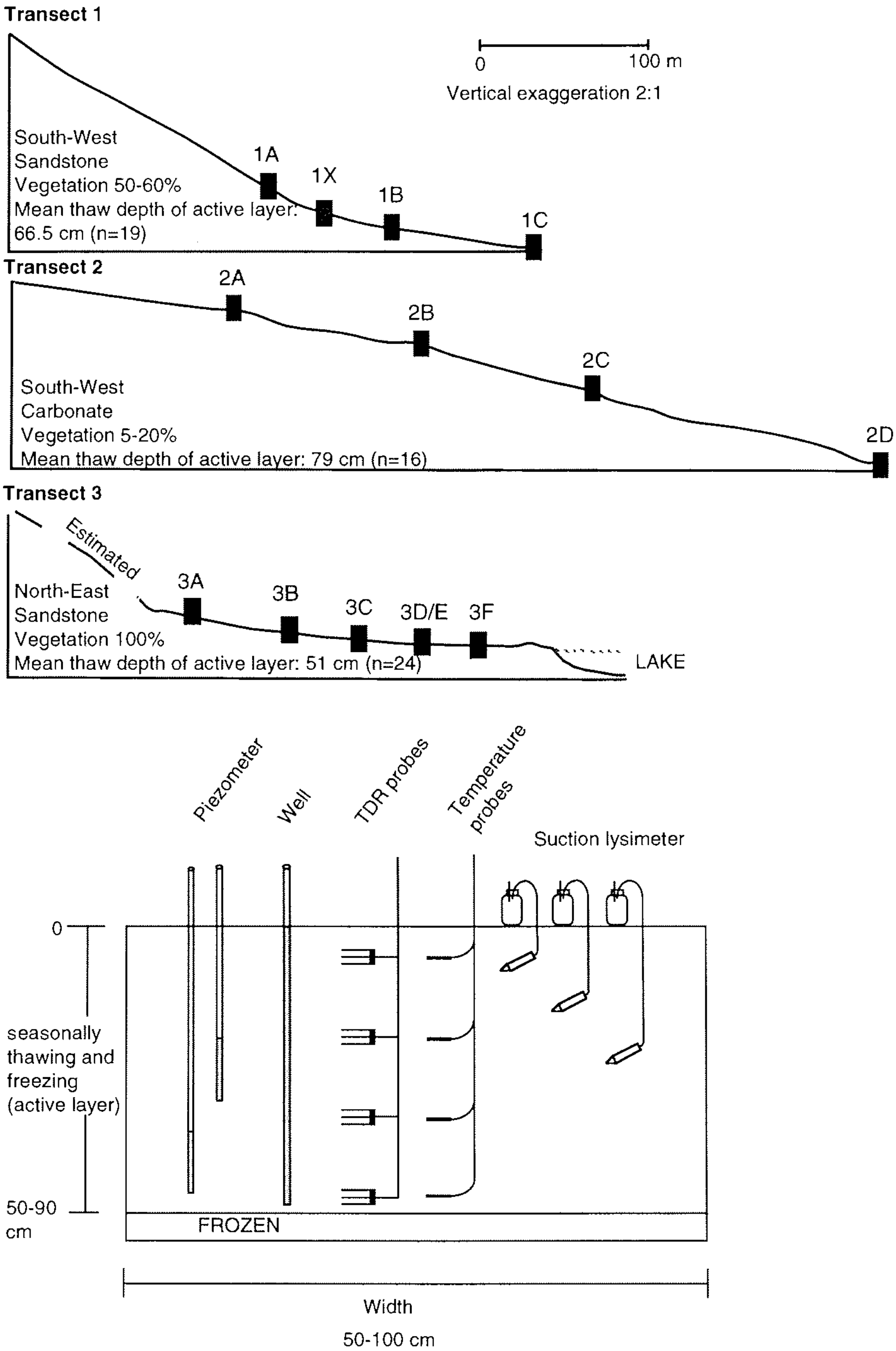


Figure 2.11: Cross section of transects and schema of instrumented soil pit

Table 2.2: Depth (cm) of installed instruments on transects 1, 2, 3

Site	TDR/Temperature Probes							Suction lysimeters					Piezometers#			Wells	
	1	2	3	4	5	6	7	1	2	3	4	5	1	2	3	1	2
1A	51	36	21	7				45	30	15			20	29		50	58
1B	57	35	20	7				45	30	13			59	29		57	57
1C	60	40	27	9				45	30	15	60		28	55		69	57
1X	53	39	23	8				45	30	15			49	27		54	
2A	78	60	41	15				74	45	17			54	22		78	
2B	75	54	37	17				50	30	15			65	26		71	
2C	77	52	30	13				52	35	15			78	39		79	
2D	46	26	6					47	26	12			35	19		46	
2X	78	65	52	47	34	23	11	61	50	40	30	20	73	37		77	
3A	45	24	9					35	15				24	27		47	
3B	32	20	11					30	15				28	15		30	
3C	30	19	9					30	15				29	13		29	
3D	31	10						15	30				40	27	16	33	
3E	28	13						15	30				21	14		22	
3F	26	16	9					25					17			24	
3G													52	27	17		
3H													40	15		36	
3J													43	17		40	
3X	21	15	7					30	15				21	12		22	

depth of bottom of screened intervall (10 cm)

- effects of active layer' refreezing on moisture and ion distribution;
- migration of recently formed waters into the frozen ground using the radioactive isotope tritium (^3H).

2.3 Studies of the Influence of Human Activity on the Environment

D.Yu. Bolshiyanov

Investigations of the level of contamination were carried out. 10 water samples from the surface of Levinson-Lessing Lake and at a depth of 20 m were sampled. Six samples of lake sediments from depths of 0-2.5, 2.5-5.0 and 5.0-7.5 cm under the bottom were taken at two points in the lake (see Figure 2.2.).

A new instrument "Cyclon" was tested and provided the opportunity to collect samples of particles greater than 5 microns in size which are transported by air masses. 16 water samples were recovered, with particles collected over periods from two days to one week. The collection period depended on the duration of a prevailing wind direction. The Cyclon functioned from 24.07.94 until 30.08.94 and was located near to the automatic weather station. Both of them were installed on the first terrace of the Krasnaya River, 500 m to the north of the delta.

All samples of water, sediments and "air" are being analyzed to determine heavy metal and organic chlorine compound contents. 30 samples of lichens from the flood plain of the Krasnaya River have been collected for the determination of the concentrations of the same contaminants.

2.4 Geobotanical Studies

M.P. Zhurbenko

Vegetation studies in the Levinson-Lessing Lake catchment had the following aims:

- landscape mapping;
- to display the diversity and abundance of local flora, including the higher plants and microbiota (fungi and lichens);
- to define the floral and microbiotic distribution of different landscape types .

During the field season, 300 samples of fungi, 8000 samples of lichens and 50 samples of higher plants and mosses were collected. 120 descriptions of the vegetation cover in typical landscapes were also made.

The vegetation of the Levinson-Lessing drainage area belongs to a typical tundra zone, with some characteristics of the arctic tundra. The vertical zonation of vegetation is very clear. Most of area is occupied by medallionical, spotted tundras with *Drias octopetala, Salix polaris* and *Cassiope tetragona* domination. Shrubs are sporadic and sparsely distributed *(Salix arctica, S. reptans, S. pulchra)*. The greatest vegetation diversity was found on the marginal meadows on the first terrace of the Krasnaya River. Some of the discovered plants are very interesting in regard to botanical geography. The lichen *Teloshistes contortuplicatus* is a new species for the region north of Krasnoyarsk; *Acarospora putoranica*, previously known from the Putorana plateau, has now been found in the Byrranga mountain. The lichens *Sticta arctica* and sedge *Carex maritima* are species typical of the seaside are spread to the south. They can be considered evidence of ancient marine transgressions to the Central Taymyr region.

All collections of vegetation are currently being studied and significant results are expected.

3 INVESTIGATIONS IN THE LABAZ LAKE AREA

3.1 Paleogeographical Investigation of Permafrost

C. Siegert, S.F. Khrutsky † and A.Yu. Derevyagin

3.1.1 Background Information

The Late Pleistocene development of the landscapes in the Taymyr Lowland, especially with regards to the extent of the last glaciation, remains unclear (Velichko, 1993). Recently, the role of marine transgression in the Late Quaternary has also been discussed (Bolshiyanov, 1994). Permafrost investigations can yield an important contribution to a clarification of these problems.

The Labaz Lake is located in eastern part of the Taymyr lowland tundra. It is assumed that Labaz and several neighbouring lakes are relicts of a huge glaciolacustrine basin, formed in the Zyryansk (Early Weichsel) glacial period (Kind & Leonov, 1982). During the Karginsk (Middle Weichsel) marine transgression, the Labaz area kept its continental conditions. Apparently this territory was not glacier-covered during the Sartan (Late Weichsel) period (Baulin & Danilova, 1984; Velichko, 1993). At the termination of the Pleistocene and during the Holocene, landscape forming processes developed here under permafrost conditions. In all probability, for the last 50.000 years B.P. the climatic conditions favoured a continual development of permafrost. It is expected that ice-rich subaerial deposits syngenetically turned into permafrost and that coexisting subaquatic lacustrine and fluvial sediments formed permafrost epigenetically. Investigations of permafrost deposits of the Labaz region can therefore be effectively used for paleoenvironmental reconstruction.

3.1.2 Research Objectives

Cryolithological investigations of Late Quarternary permafrost sediment profiles should contribute to explaining the Late Quaternary environmental development of the Taymyr region. Combined with dating techniques, paleontological, sedimentological and geochemical methods, these investigations should elucidate the relationship between climate change and the development of permafrost landscapes. Observations of recent cryogenic processes (thermokarst, thermoerosion, solifuction) at the lakeshore of Labaz Lake and other, local sedimentation basins will limit their influence on transport and accumulation of sedimentary material under the stated geomorphological and geocryological conditions. These observations will serve as a basis for the paleogeographical interpretation of the cryolithological structure of the region's fossil permafrost profile and those of bordering lowland areas.

3.1.3 Materials and Methods

Late Pleistocene permafrost sediments of the north shore of Labaz Lake were investigated at 17 exposures. The conditions on the steep north shore were sufficient to allow investigation (Figure 3.1). It rises 20 to 40 meters above the lake surface and is heavily influenced by thermoerosion, solifluction and thermokarst phenomena. The south shore was formed by Holocene accumulation terrasses. In the outflow area of the Boganida River, two exposures (LAO-13, LAO-14) of Holocene sediment were investigated. North of Labaz Lake, in a level, limnic-alluvial depression with isolated remnant lakes, 6 cores were recovered (Table 3.1). The resulting permafrost profiles (maximum thickness 4.5 m) were supplemented by recent soil profiles (see chapter 3.2). The permafrost temperature distribution was measured in the two deepest boreholes, which were strengthened with polystyrene liners, by means of a ground thermometer chain.

Frozen ground facial analysis was the basic method for geocryological investigations of permafrost profiles in the field. This method is based on the relationship between the cryogenic construction of sediments or sediment complexes and the conditions in permafrost landscapes at the time of sediment freezing (Katasonov, 1973, 1978).
The cryogenic construction of sediments includes the following elements:

1 - the cryostructure (cryogenic structure) of the sediment: the type, content, morphology and spacial distribution of segregated ground ice and ice cement in the sediment. This allows conclusions to be drawn con cerning the genesis of the sediment as well as the hydrological and thermal conditions at the time of transition of the sediment to permafrost.
2 - cryogenic or frost-caused phenomena in sediment complexes: ice wedge polygons, other frost fissures, cryoturbation, bodies of ground ice created through injection processes, etc.

The main goal of sampling procedures during initial field work was to obtain organic material for C-14 dating and to recover samples suitable for pollen analysis. With these data we hope to register the entire C-14 recoverable record of the continental development of the Labaz area. In addition, paleobotanical investigations of peat samples in good condition will be undertaken.

Ice rich permafrost sediments, which have been formed in flood plains, hillslopes, swampy lakes and peats, were also sampled for analysis of their isotope signatures ($\delta^{18}O$, $\delta^{2}H$, $\delta^{3}H$). Similar analyses will be undertaken with surface waters and precipitation. Analyses of $\delta^{18}O$, $\delta^{2}H$ should provide paleoclimatic information. Studying the tritium distribution in ground ice and ice rich permafrosts will serve to elucidate water migration in the frozen ground.

The sediment samples will be analysed using the following lithological methods: grain size analysis, clay compostions, mineralogical and chemical investigations of the character of post-depositional changes in the sediment by soil-forming or diagenetic processes (authigenic minerals, extractable Fe and Mn,

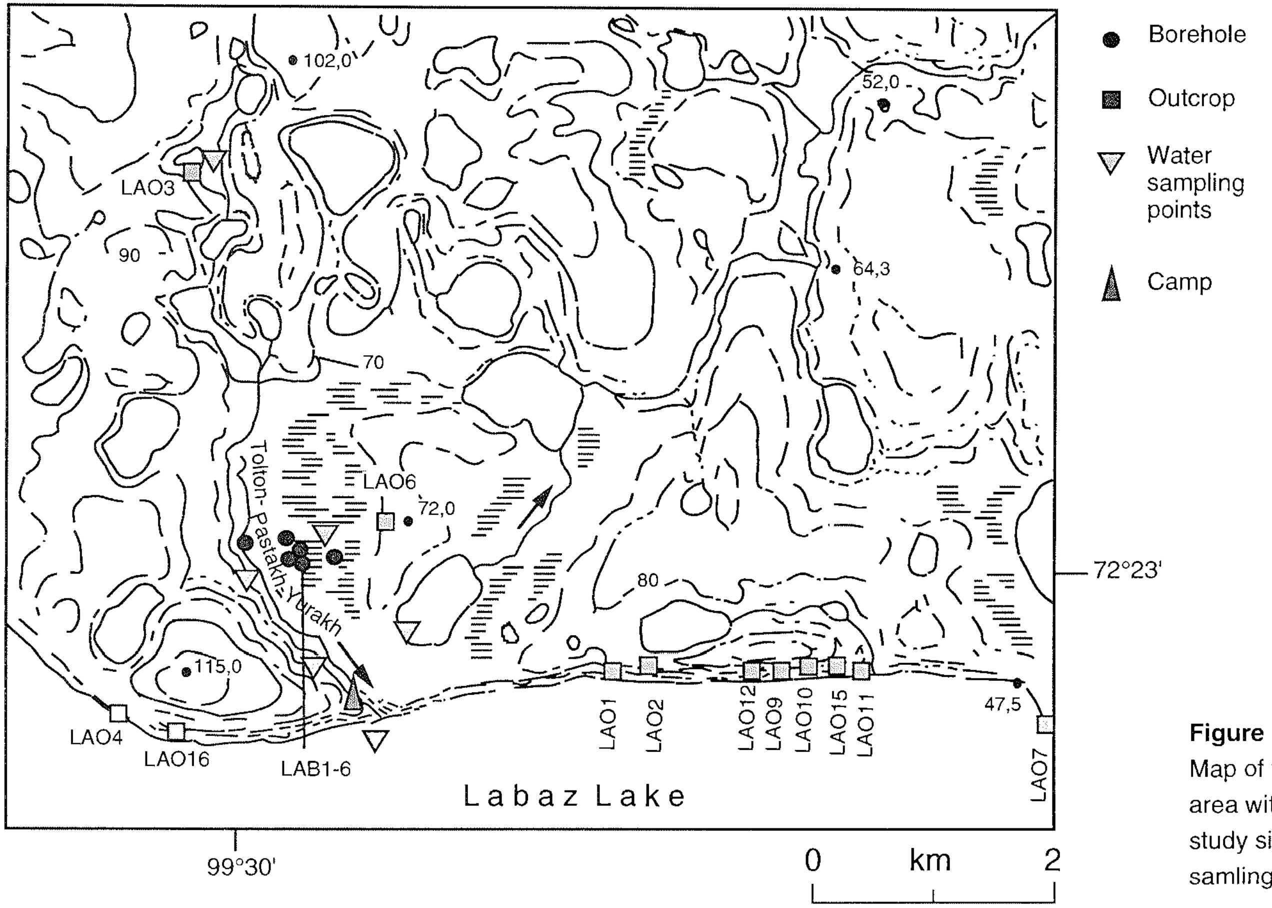


Figure 3.1:
Map of the main working area with location of the study sites and water samling points in 1994

Table 3.1: Sediment Profiles in Permafrost in the Labaz Lake area

Site no.	Position Latitude	Longitude	Type of exposure	Profile depth [m]
LA-B1 -1•	72°23'15"	99°40'50"	B	4,59
-2*			D	0,32
-3*			O	2,00
LA-B2 -1*	72°23'20"	99°40'50"	B	3,85
-2*			D	0,42
LA-B3*	72°23'18"	99°41'15"	B	1,10
LA-B4*	72°23'18"	99°41'16"	B	2,60
LA-B5*	72°23'19"	99°41'18"	B	3,05
LA-B6 -1*	72°23'20"	99°41'18"	B	2,00
-2*			D	0,43
LA-O1	72°22'52"	99°45'50"	O	3,20
LA-O2	72°22'53"	99°46'50"	O	12,80
LA-O3	72°25'27"	99°39'40"	O	1,90
LA-O4	72°22'40"	99°39'	O	4,00
LA-O5 -1*	72°22'55"	99°27'40"	O	2,84
-2			O	3,30
LA-O6*	2°23'18"	99°42'30"	O	2,40
LA-O7	72°22'45"	99°52'50"	O	1,20
LA-O8*	72°22'15"	99°52'25"	O	30,70
LA-O9	72°22'55"	99°48'35"	O	1,80
LA-O10	72°22'56"	99°49'05"	O	1,50
LA-O11	72°22'58"	99°49'40"	O	2,30
LA-O12	72°22'54"	99°48'10"	O	0,60
LA-O13*	72°11'15"	99°35'	O	2,10
LA-O14*	72°11'40"	99°36'	O	0,95
LA-O15	72°22'58"	99°49'25"	O	10,00
LA-O16	72°22'32"	99°39'50"	O	8,0
LA-O17	72°22'27"	99°54'15"	O	3,0

Sites marked • = profiles with detailed sampling
Typ of exposure: B = bore hole, D = digging pit, O = outcrop.

carbonate content, C, N, S, ^{13}C). An overview of the retrieved sample material in the most typical profiles and the planned analyses is presented in Appendix: Table 7.2.

3.1.4 First Results

Cryolithological Study of Permafrost Profiles

Results obtained in field work show that alluvial and lacustrine swamp processes dominated during the Late Pleistocene and Holocene. Primarily ice-rich permafrosts with ice contents of 60 % (by volume) and higher were formed.

Numerous sedimentary cycles were discerned within the various Late Quaternary sediment complexes of the Labaz basin (Figure 3.2). They first cycle began likely in the Kazantsev (Eem) Interglacial with the formation of deep basin deposits and ended with littoral sediments overlaid by subaerial deposits. The younger cycles began with the formation of subaquatic lacustrine and alluvial sediments and end with peat and swamp deposits. The former were transformed into permafrost without the direct influence of cryogenic processes through epigenetic freezing (i.e. after the action of early diagenetic processes). The epigenetic permafrost deposits are evidenced through lattice-like cryostructures (Figure 3.3). The latter, shallow water sediments made the transition to permafrost syngenetically under subaerial conditions. They were evidenced by characteristic banded and lens-shaped cryostructures (Figure 3.4). Polygon ice wedge systems penetrate the subaerial Pleistocene deposits to depths of up to 10-15 m, and the Holocene deposits by up to 3-5 m.

For the first time in the easthern part of the Taymyr Lowland it was possible to prove the existence of thick ice wedge systems in the deposits of the Zyryansk glacial margin area. The deposits of this Zyryansk "ice complex" contain almost no visible organic material but have increased amounts of coarse, clastic materials (gravel, pebbles) (see Figure 3.2). The sediment lying between the ice wedges is enriched with segregated ice. These facts support the conclusion that temperatures at the time of the permafrost horizon`s formation were very low. Such cold conditions are characteristic for periglacial zones of the arctic desert.

Although similar sediments correlate to the Kaginsk period (first results of radiocarbon dating: 43.900, > 47 000 years B.P.) in their cryological formation, they contain much less ice. The size of the polygon ice wedge system is smaller. The clearly layered, sandy-silty sediments are composed of many horizons, in addition to containing humus or allochthonic organic material (Figure 3.5). These facts suggest more favourable conditions for vegetation and a pronounced seasonal cycle during sedimentation.

The environmental conditions during the termination of Pleistocene and in Holocene was subject to observable variations. Evidence exists for changes between warming and cooling phases. After erosion intervals, the river valleys

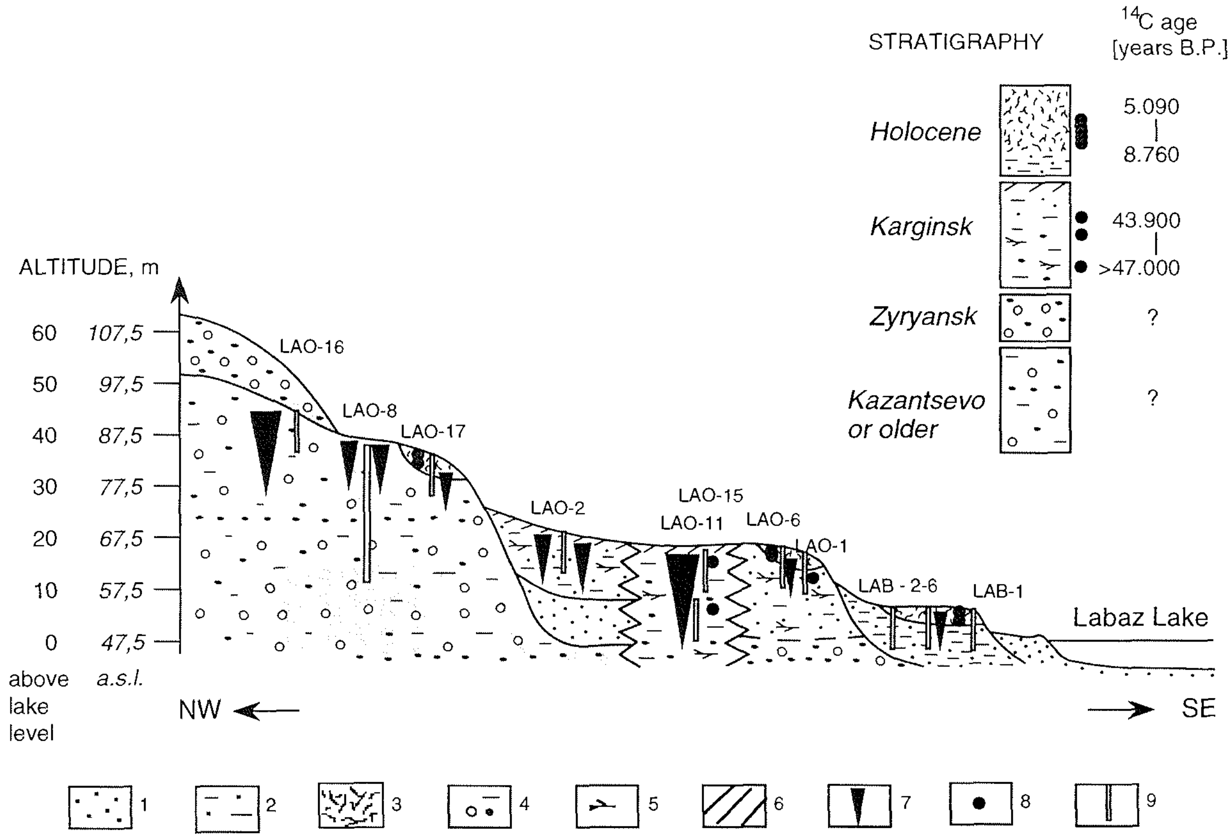


Figure 3.2: Schematic section and stratigraphy of Quaternary deposits in the northern shore zone of the Labaz Lake

1 - sand, 2 - sandy clay silt, 3 - peat bed, 4 - loam with pebbles, gravel, till stones, 5 - plant remains, 6 - loamy slope deposits, 7 - ice wedge, 8 - sample for radiocarbon dating, 9 - study site.

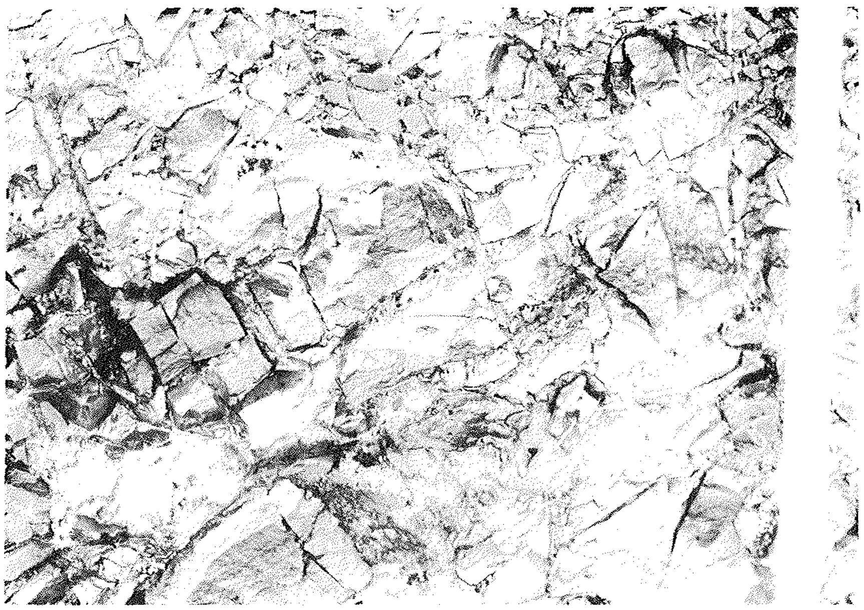


Figure 3.3: Lattice-like cryostructure of epigenetic frozen ice-rich glaciolacustrine clay silts exposed in LAO-10 on the Labaz Lake level. The cement of the brecciated sediment is segregeted ice. The witdth of the folding rule - 18 mm.

were filled in. Numerous lakes in thermokarst depressions, formed at the beginning of the Holocene, were also filled in. The environmental conditions favoured widespread peat formation.

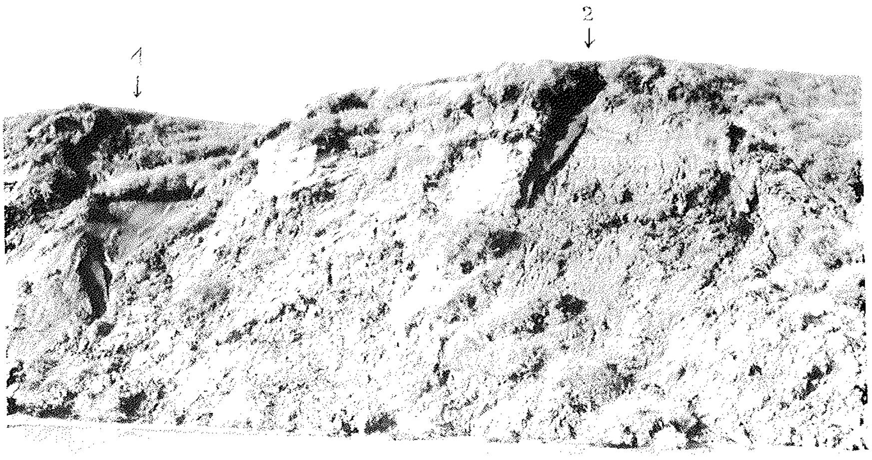
Recent Geocryological and Sedimentary Processes

Because the very ice-rich Late Quaternary deposits in the Labaz area lie near the ground surface, the development of thermokarst, thermoerosion and solifluction features is favoured. Seasonal and perennial snow fields play an important role for weathering and sediment transport. It is estimated that through these processes about 500 m^3 of material (clay, silt, sand, pebbles and till, as well as organic material) was transported from the 12 km long north shore into the lake over a two month period (July-August 1994).

The rivers flowing into Labaz drain an area with a very low amount of local relief. Abundant lakes and swamps moderate the output of the rivers. In winter the rivers freeze down to the riverbed and isolate the lake. The predominantly 100 % plant cover protects the drainage area from erosion, with the exception of the lakeshores, and results in a low fluvial contribution of suspended sediments to the lake. The sediment accumulation on slopes, valley floors and in shallow water areas is accompanied by syngenetic sedimentation. The weakly indented relief and shallow ground thaw (mean thaw depth 0.4-0.5 m) leads quickly to saturated ground conditions in the Labaz catchment area. Newly formed permafrost is evidenced by a high ice content. Ice-wedge polygons at various stages of formation are widely distributed over the catchment area.Temperatures of the permafrost at depths of 4-5 m are 8.5-9.4 °C. The low temperature of the permafrost limits the existence of taliks (perennially thawed bodies) below lakes or rivers, which could only be expected beneath deeper water.

Figure 3.4: Stratified lens-shaped cryostructure of syngenetic frozen alluvial-lacustrine sandy clay silt (LAB-2; 3,10 m). Lenses of segregated ice - dark gray, the width of drill core is 59 mm.

A



B

Figure 3.5:
The Late Pleistocene "Ice-complex" exposed past earth slides on the high bank of the Labaz Lake.
A - show to the left a old thermokar located over the ice wedge 1, to the right of ice wedge 2 - layered syngenetic frozen clay-silty sand with banded and lens-shaped cryo-structure.
B - show a detail of ice wedge 2. Photos 28.08.1994.

Tritium in Permafrost

A.Yu. Derevyagin

Seventeen samples of permafrost rocks for tritium analyses were obtained for the first time in the Labaz area.

The aim of our investigations is to study water migration and recent formation of ground ice at the boundary between the seasonally thawed layer and the frozen ground. This study is a part of the project ‚Tritium in Permafrost' of the Fundamental Research Fund of the Russian Academy of Sciences. The first stage of the project (1994) is devoted to the collection of data from tritium analyses of permafrost and of ground ice samples for further analyses. The resulting data will allow conclusions to be drawn concerning the presence of segregated ice formations and the phenomenon of differential tritium levels in permafrost (from 10 to 98 T.U.). Tritium concentrations in samples of water and snow taken from the Tolton-Pastakh-Yuryakh river valley currently have levels of 40-43 T.U. These data will allow us to elucidate the dependence of permafrost tritium levels on permafrost age, genesis and composition.

3.2 Characterization of the Organic Matter in Permafrost-Affected Soils

E.-M. Pfeiffer and J. Hartmann

3.2.1 Object

Within the scope of the project "Late Quaternary Environmental Development of Middle Siberia", the soil organic matter from permafrost-affected soils (Cryosols) in the Taymyr region should be investigated. The main parameter of the carbon-cycle in the subarctic region - as there are soil substrate and soil processes, vegetation, relief, hydrology, climate - will be determined by soil survey. The aim of research - by using C-fractionation and isotope investigation - is to characterize recent decomposition processes of carbon in permafrost-affected soils as well as in ancient soils in permafrost sequences. This characterization will allow a reconstruction of the paleoenvironmental conditions.

3.2.2 Materials and Methods

For the description of soil morphology we used the German soil survey manual ("Bodenkundliche Kartieranleitung 1982"), the US soil survey manual 1993 and "FAO Guideline 1990". The important site parameters are: structure and decomposition of the organic surface layers, thickness of diagnostic horizons, content of stones, soil color (Munsell soil color charts 1988), organic matter content, water influence, root restricting depth, particle size distribution, proof of reduced iron with α-α-Dipyridyl, bulk density, soil structure, parent material, thickness of active layer, the upper permafrost layer and its ice content.

Samples of typical soils (horizons, combinated with 10 cm-wize layers) and of typical plant species (2 plants/site) for isotope investigations were collected. The samples were air dried and prepared for transportation by ship. Soil was classified according to American Soil Taxonomy, Soil Survey Staff, 1994. The relation to the Russian classification system was difficult because of language problems and a lack of literature.

3.2.3 Soils in the Labaz Region

The first inventory of soils in the Labaz Lake area was carried out by classification of typical vegetation and geomorphological and hydrological conditions in cooperation with the other working groups, especially with M. Sommerkorn (see chapter 3.3). Six sites with different moisture regimes and vegetation were selected for sampling. They represent 90% of mainland soils. The distribution of the soils is shown on Figure 3.6. The main profile characteristics for investigated soils are given in the Appendix (7.3).

Predominant are gleyic soils with different aquic soil moisture regimes and a pergelic soil temperature regime. The permafrost layer prevents the vertical percolation of rain and meltwater. That causes waterlogging in the overlying active layer and reduction processes are predominate. Above the permafrost boundary an accumulation of organic material and reduced oxides could often be recognized.

Besides the gleyic soils there are peat soils in the wet depressions with moderately to strongly decomposed organic material. Soils in dryer areas - as for example on the tops of hills and on steep slopes - are more weathered. The characteristics are a weak cambic horizons [Bw-horizon] with loamy texture.

Strong solifluction (slow creeping of wet soil) only occurs in some areas, to be seen on the steep slopes of Labaz Lake. It is difficult to explain the genesis of the stone-rich solifluction-material near site 1. This material is not wide spread and does not correspond to the unsorted stone circles; it can perhaps be interpreted as old deposition material of the Pre-Labaz-Lake period.

3.2.4 Thickness of Active Layer

Soil forming processes in areas underlain by permafrost take place in the active layer - the upper seasonally thawing horizon. The thickness of the active layer depends on many local factors and varies a little depending on the annual climatic situation. In the Labaz Lake area, the average thickness of the active layer ranges between 0.4 and 0.5 m depth. The thinnest active layers are found in organic soils. Under thick and weakly decomposed organic surface layers - mostly in depressions and under peat - the permafrost starts at 0.1 m depth. Well drained mineral soils could have a deep active layer with a

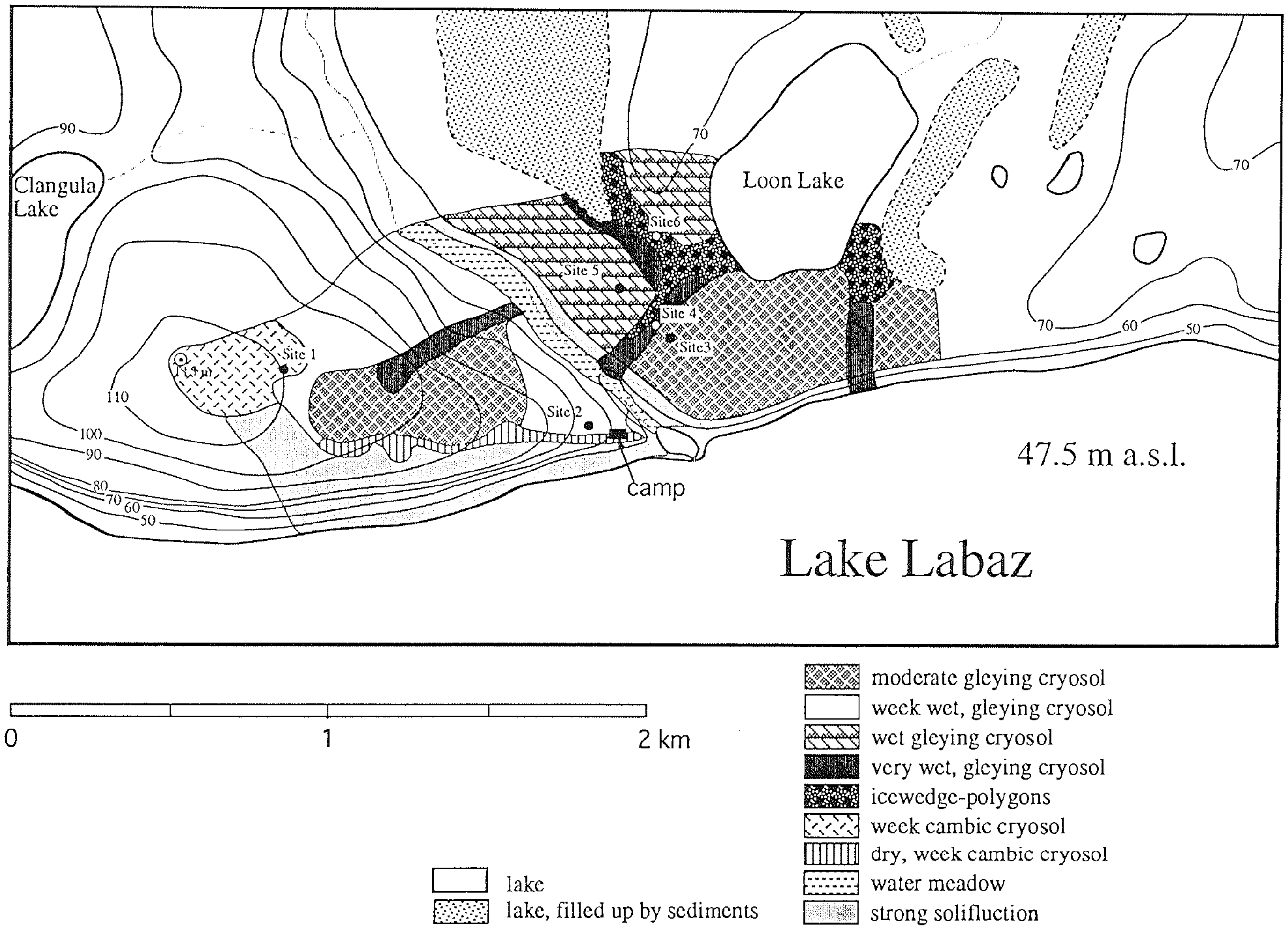


Figure 3.6: Soil distribution in the study area.

thickness of 1.10 m and more (for example site 1, A. 7.3). The mapping of the thickness of the active layer was made more difficult by rock fragments and by solifluction.

3.2.5 Planned Research in 1995

In vitro Measurements

The soil organic matter (SOM) including the dissolved organic carbon (DOC) will be fractionated by special exchange resins (according to Malcolm et al., 1977; Ping et al., 1995) into humic acid, fulvic acid and lower molecular organic substances. The organo-mineralic complexes will be fractionated by their density (see Figure 3.7). The $\delta^{13}C$-values will be determined for these fractiones, for the plant material and for the main gas compounds like CH_4 and CO_2, which are formed under anoxic conditions. The ^{13}C value of the fractions will help us to understand their role in carbon decay under permafrost conditions.

In addition, the total contents of the main elements (C, N, P) and the dithionid-soluble-iron – as an indication of weathering – will be analysed. Important soil physical parameters – like texture, pore size distribution and water permeability – will be determined.

In situ Measurements

One of the main research activities during the Taymyr Expedition 1995 is the characterization of the organic surface layers, the peat horizons and the soil organic matter (SOM). Important is the degree of decomposition, morphology, boundaries, quantity and distribution of roots, structure and amounts of mineral particles. The main parameters of the carbon cycle - temperature, acidity, moisture, redox potential - will be measured at some typical sites of the Labaz area. *In situ* measurements of the biomass production and the decomposition rates of typical permafrost landscape sites will be done.

The soil and site mapping will be continued to complete the soil and vegetation spectrum of the Labaz area. Some more intensive SOM research will be done.

3.2.6 Coordination with other Working Groups

The planned SOM investigations will be coordinated with the other members of the common project. The characterization of soil organic matter in combination with vegetation and microbial activities - performed by project members at Kiel - will further an understanding of the processes of the carbon cycle and the decomposition of SOM under permafrost conditiones. Knowledge of recent soil processes in connection with the results of geocryological and paleontological studies of Late Quaternary permafrost sequences in the Labaz

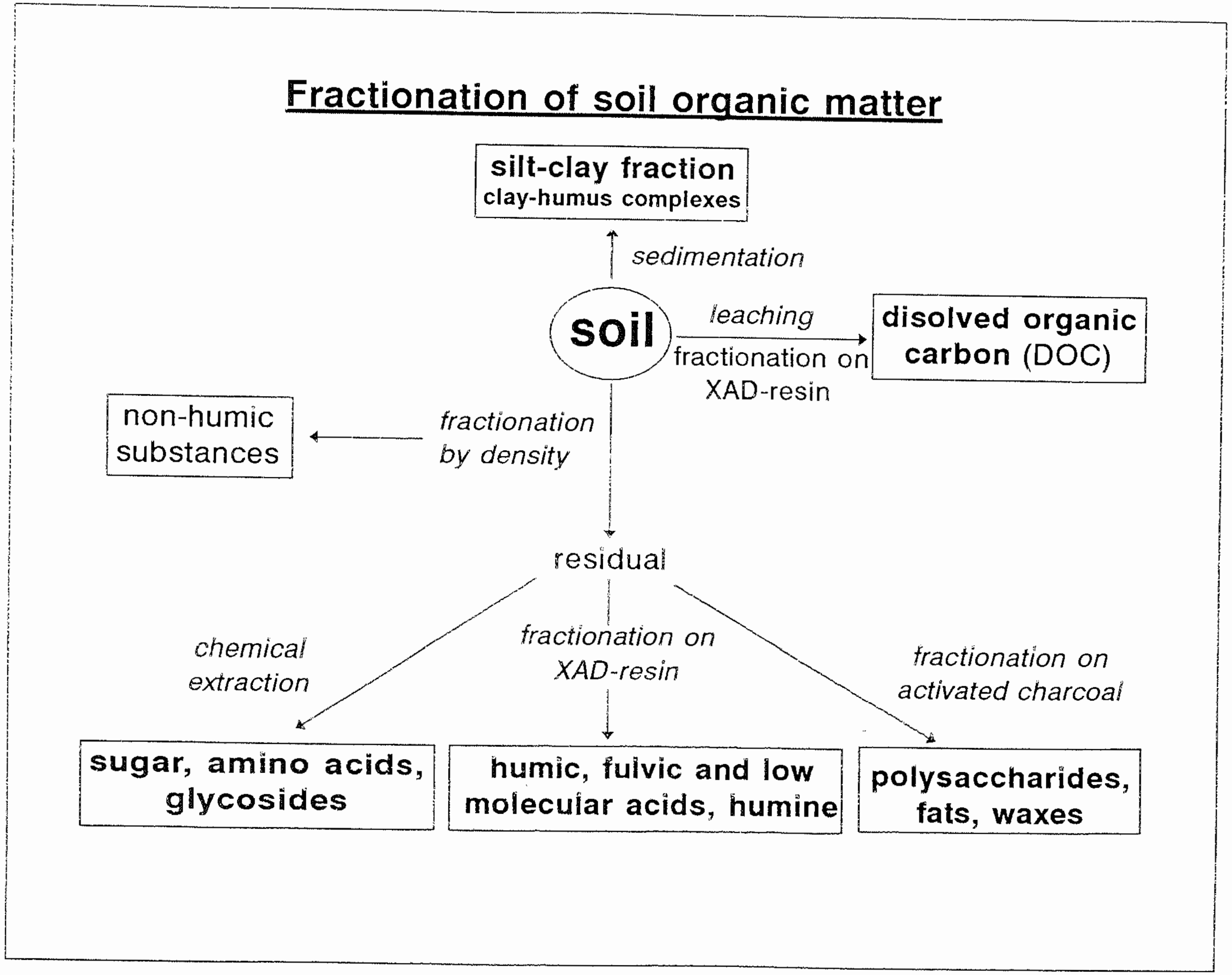


Figure 3.7: Schema of the soil organic matter fractionation in collected samples.

area – obtained by colleagues at Potsdam – are important for the reconstruction of the paleoclimate and environmental changes.

3.3 Microbial Communities and Carbon Turnover in the Tundra

Martin Sommerkorn

3.3.1 Aim of the Study

Within the scope of the project "Late Quaternary Environmental Development of Middle Siberia" this part should lead to knowledge about biological, especially microbial processes in arctic and subarctic tundra soils. Such data are important for the understanding of soil generation and carbon accumulation processes in the present and past and thus for knowledge about the development of the Middle Siberian Tundra. Conclusions can be made about the ratio of primary production to microbial respiration and further about the carbon balance of the tundra system. Special emphasis is given to characterizations of plant- and microbial communities and their ecophysiological reaction to microclimatic parameters.

3.3.2 Methods

The 1994 field season at Lake Labaz was used for work on the following topics:

- Characterization of vegetation/ soil complexes
- Continuous recording of soil temperatures and active layer depths
- Soil sampling for laboratory analysis of soil respiration, microbial community structure and for microcalorimetric measurements.
- Preparation of plots for *in-situ* CO_2-measurements in 1995

Vegetation analysis was carried out by frequency and coverage analysis. Species were determined following species lists from central Taymyr. Critical taxa were compared later with specimens at the herbarium of the Komarov Botanical Institute, St. Petersburg.

Microclimatic measurements were carried out through the use of dataloggers (Grant Co., Cambridge, UK) with microthermistor probes. For soil sampling we used metal cylinders (diameter 50 mm). Special attention was given to small scale morphological differences (ice wedge/tussock). Samples were stored in 50 mm high plastic containers, air dried and taken to Kiel by plane for further analysis. Samples for botanical and microbiological data were taken beside the samples for physicochemical parameters (Institute for Soil Science, Hamburg) to allow direct comparison of results.

3.3.3 Results

3.3.3.1 Vegetation / Soil Complexes

In the research area eight different vegetation/soil complexes were characterized (Figure 3.8), from which the four dominating ones were analyzed. Differences between the complexes are mainly due to different hydrological regimes.

Dry chionophobous ruderal aggregation.
The driest complex can be found on the top of hills on slightly ded terrain. Soil surface is gravelly and does not appears to be affected by cryoturbation. Fine material can be found below 5 cm soil depth and seems to be eroded by wind. This is supported by plant composition (Table 3.2) and the low degree of plant coverage (79 %). The present species indicate dryness and furthermore a lack of snow during winter as a result of high windspeeds and the deep temperatures to which the soil surface is exposed at that time. At this site we measured the deepest active soil layer depth of the area of more than 1 m.

Mesic spotty tundra.
The mesic complex is formed by a spotty tundra. This type is found neighbouring shore and streambank regions where the suprapermafrost water can run off. Thus there are no *Eriophorum*-species present which could form tussocks. Instead, hummocks (diameters 1.3 m to 1.8 m) are formed by cryogenic processes. They are separated by small ice wedges. On hummock, active layer reach depths up to 55 cm; on ice-wedges depths of 31 cm were measured. Species differences between microstands reach maximum values in this type of tundra (Table 3.3). Ice wedges are dominated by mosses and grasses, flanks of the hummocks are covered by high percentages of dwarf shrubs, while the top of the hummocks show high frequencies of lichens. The number of lichen species is also highest in this tundra type.

Humid tussock tundra.
The complex dominating the studied area is a humid tussock tundra on even terrain. Tussocks are formed by *Eriophorum vaginatum*, which dominate the character of both vegetation and upper soil horizons. The diameter of the tussocks is 30 to 90 cm, the heigh ranges from 10 to 25 cm. Dwarf shrubs and herbs occur in high percentages (Table 3.4). Between the tussocks mosses and grasses dominate the vegetation. Mosses alone cover the soil by 71 %, grasses moreover by 45 %. Under the tussocks the depth of active layer reaches a maximum of 55 cm; between the tussocks 42 cm were measured.

Wet sedge tundra.
The wettest complex of the area is a wet sedge tundra. It is to be found in lake depressions, filled up by sediments, or in trenches draining them. Polygon nets with edge lengths of about 10 m intersperse this tundra type in some parts. Moss coverage reaches 91 %, grasses add another 89 % (Table 3.5. The soil appears to be water saturated all summer and the suprapermafrost water reaches high current velocities. Due to this and the high content of fine

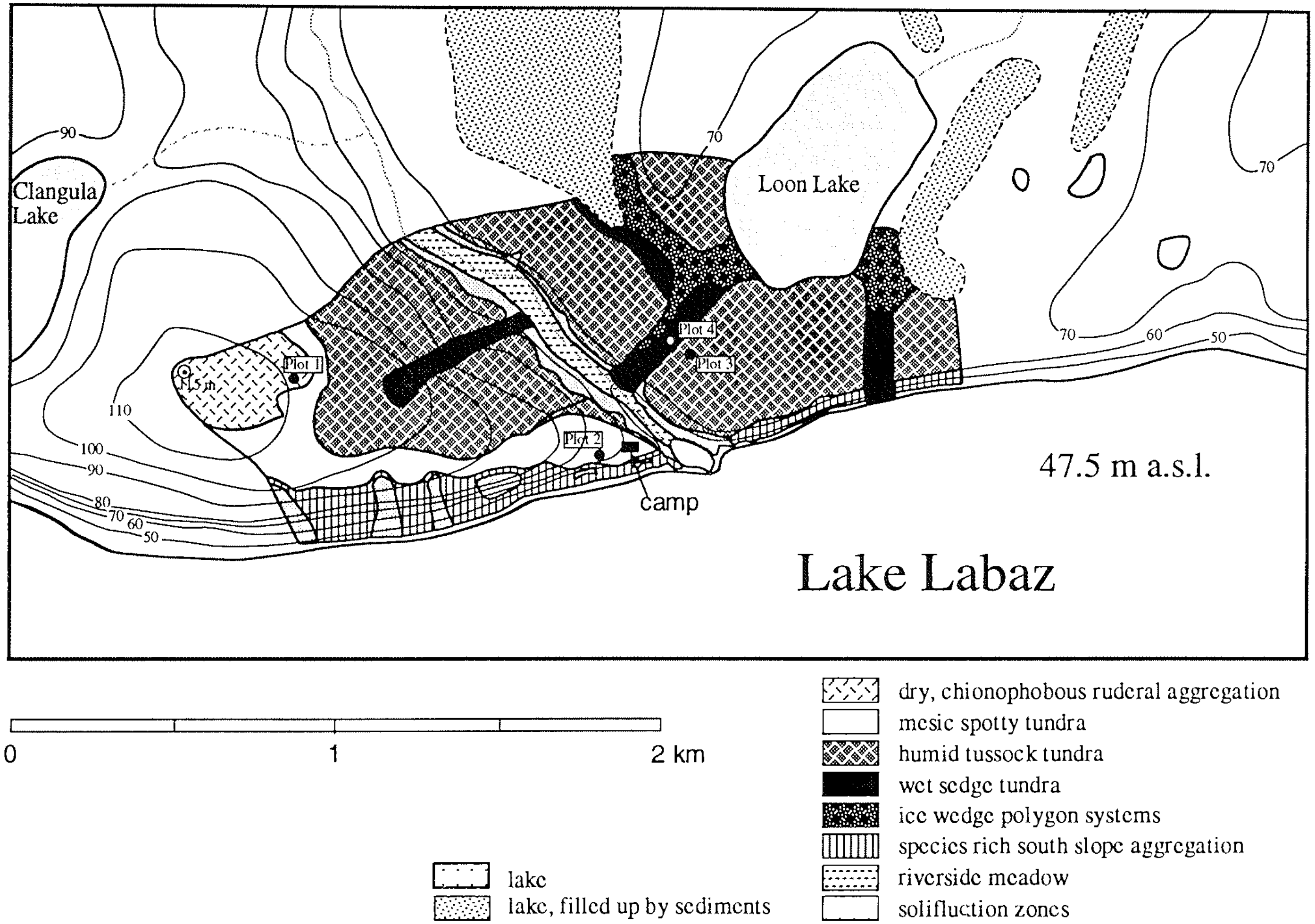


Figure 3.8: Distribution of vegetation complexes in the study area.

material in the soil, reductive horizons start already 2 cm below the soil covering moss layer. The only oxic zones occur in the rhizosphere of deepreaching *Eriophorum angustifolium* roots. The depth of the active layer in this tundra type was up to 52 cm.

Table 3.2: Species list and percentage coverage: dry, chionophobous ruderal aggregation

	frequency (thalli / m2)		
Bryocaulon divergens	93		
Parmelia omphalodes	35		
Physconia muscigena	15		
Peltigera rufescens	14		
Alectoria ochroleuca	13		
Cetraria nivalis	8		
Cetraria cucullata	1		
	sum = 179		
	coverage (%)	**group coverage (%)**	**total coverage (%)**
Dryas punctata	44		
Astragalus alpinus	13		
Artemisia furcata	1		
Eritrichum viliosum	1		
Minuartia biflora	1		
Polygonum viviparum	1		
Saxifaga branchialis	1		
		62	
Poa glauca	6		
Bramopsis pumpeliana	2		
Carex rupestris	3		
		11	
Ditrichum heteromallum	18		
Tortula ruralis	7		
		25	
			98
bare soil	22		

Table 3.3 : Species list and percentage coverage: mesic spotty tundra

	frequency (thalli / m2)		
Cetraria cucullata	210		
Thamnolia vermicularis	103		
Bryocaulon divergens	88		
Cetraria islandica	81		
Dactylina arctica	73		
Cladina arbuscula	61		
Cladonia uncialis	61		
Cladonia gracilis	56		
Sphaerophorus globulosus	53		
Peltigera aphtosa	17		
Cetraria nivalis	16		
	sum = 819		
	coverage (%)	**group coverage (%)**	**total coverage (%)**
Vaccinium vitis-idea	16		
Cassiope tetragona	14		
Betula nana	11		
Salix arctica	4		
Dryas punctata	3		
Minuartia arctica	1		
Pedicularis lapponica	1		
		50	
Luzula confusa	10		
Arctagrostis latifolia	2		
Carex bigelowii ssp.arctosibirica	2		
Hierochloe alpina	1		
		15	
Polytrichum strictum	23		
Aulacomnium turgidum	16		
Anastophyllum minutum	14		
Kiaeria starkii	14		
Hylocomium splendens	9		
		76	
			141

Table 3.4: **Species list and percentage coverage: humid tussock tundra**

	frequency (thalli / m2)		
Cetraria cucullata	145		
Cladina arbuscula	25		
Cladonia uncialis	24		
Cetraria islandica	21		
Bryocaulon divergens	8		
Dactylina arctica	5		
Nephroma arctica	2		
	sum = 229		
	coverage (%)	**group coverage (%)**	**total coverage (%)**
Betula nana	13		
Salix pulchra	10		
Vaccinium vitis-idea	10		
Cassiope tetragona	8		
Vaccinium uligunosum	5		
Dryas punctata	4		
Pyrola rotundifolia	3		
Pedicularis lapponica	2		
Polygonum viviparum	1		
Salix glauca	1		
Saxifraga hierculus	1		
Saxifraga nelsoniana	1		
		59	
Eriophorum vaginatum	24		
Carex bigelowii ssp.arctosibirica	18		
Arctagrostis latifolia	3		
		45	
Tormenthypnum nitens	18		
Drepanocladus uncinatus	15		
Kiaeria starkii	12		
Hylocomium splendens	10		
Polytrichum strictum	7		
Aulacomnium turgidum	5		
Plagomnium elatum	4		
		71	
			175

Table 3.5: Species list and percentage coverage: wet sedge tundra

	coverage (%)	group coverage (%)	total coverage (%)
Salix pulchra	10		
Ranunculus affinis	4		
Betula nana	3		
Salix glauca	1		
Rumex arcticus	1		
Potentilla palustris	1		
		20	
Carex stans	78		
Eriophorum angustifolium	6		
Arctagrostis latifolia	5		
		89	
Drepanocladus uncinatus	59		
Tormenthypnum nitens	18		
Plagomnium elatum	11		
Hylocomium splendens	2		
Polytrichum strictum	1		
		91	200

3.3.3.2 Soil Temperatures and Active Layer Depths

Soil temperatures for various depths were recorded continuously at typical plots of tundra types 2, 3, and 4 (Figure 3.9 - 3.12). Also, active layer depths at these plots were measured. Combined with the CO_2-turnover rates evaluated in laboratory studies and proposed for next year's field season, these data will be used for calculations of soil carbon fluxes. Furthermore, microclimatic data are compared with air temperatures taken at each plot and with other mesoclimatic parameters taken at the weather station of the camp for calculations of coupling of climate/active layer regimes. First impression of these data show soil dependent differences:

- The dryer the soil, the higher the depth of the active layer.
- Compared with dryer soils the surface temperature of wetter soils is ower, whereas the temperature of deeper horizons of the active layer is higher.
- Differences between surface temperatures of tussocks/hummocks become higher with decreasing diameter and increasing height of tussocks/hummocks.

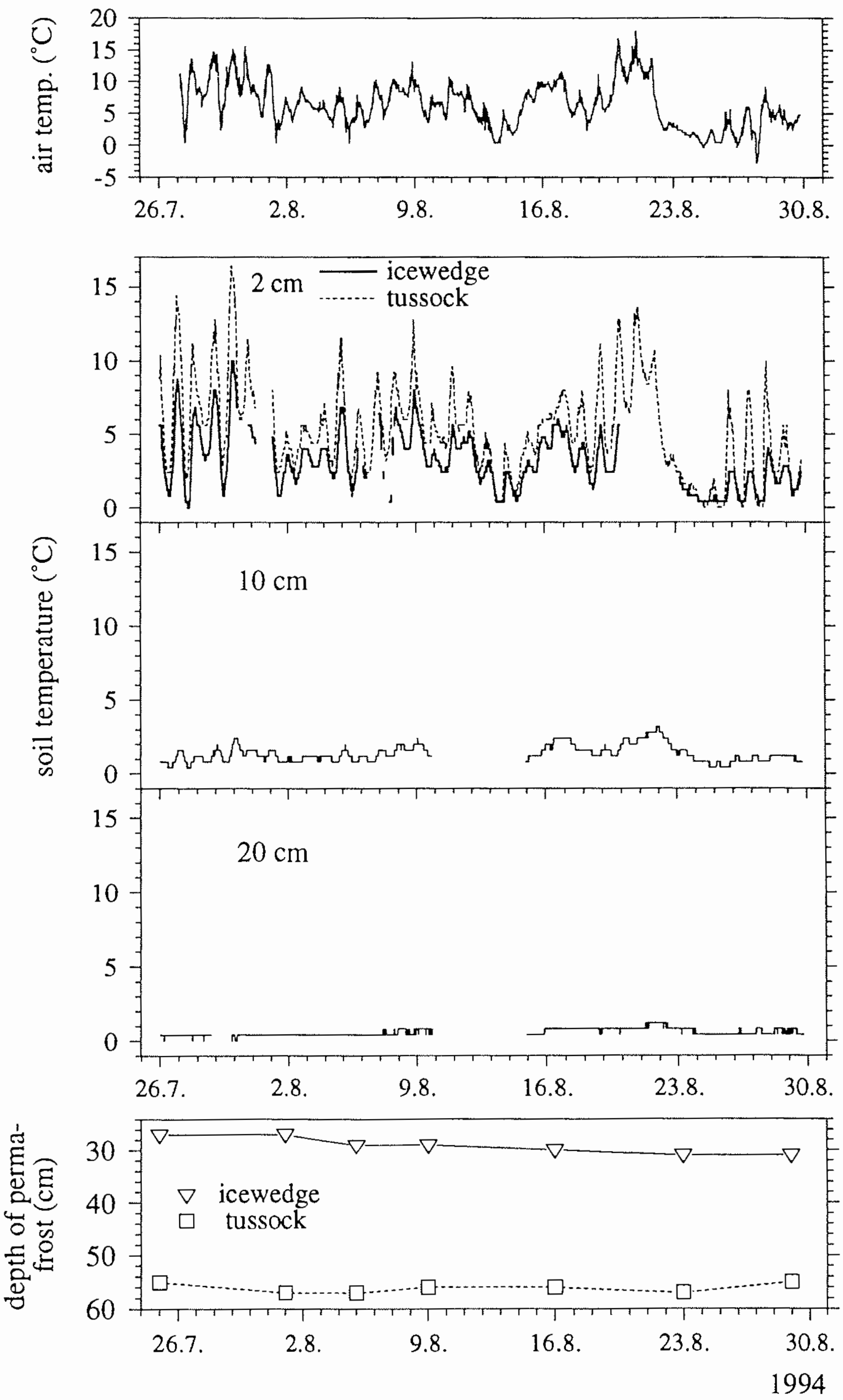


Figure 3.9: Ambient temperature, soil temperatures and depth of permafrost in mesic spotty tundra.

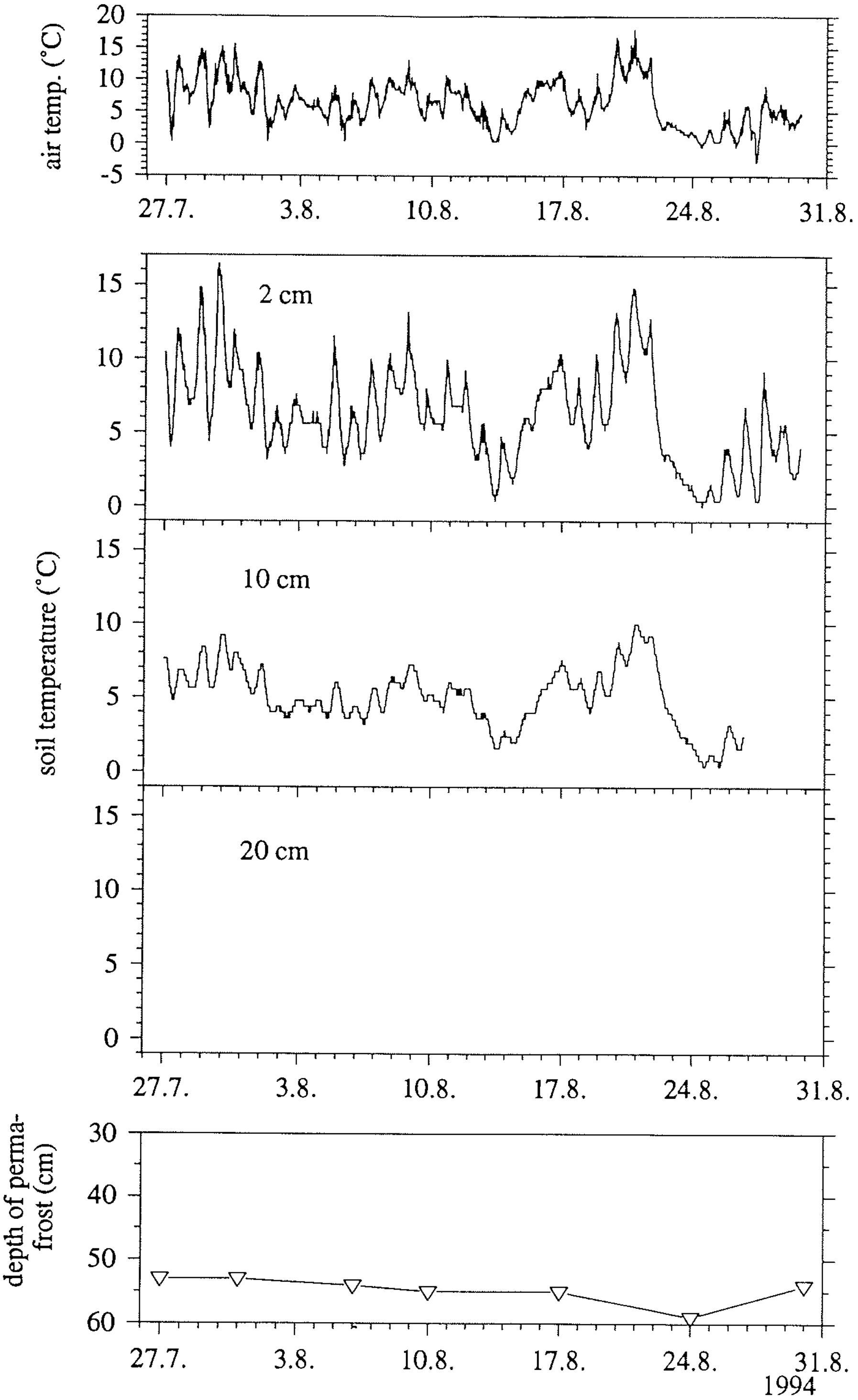


Figure 3.10: Ambient temperature, soil temperatures and depth of permafrost in humid tussock tundra, tussock.

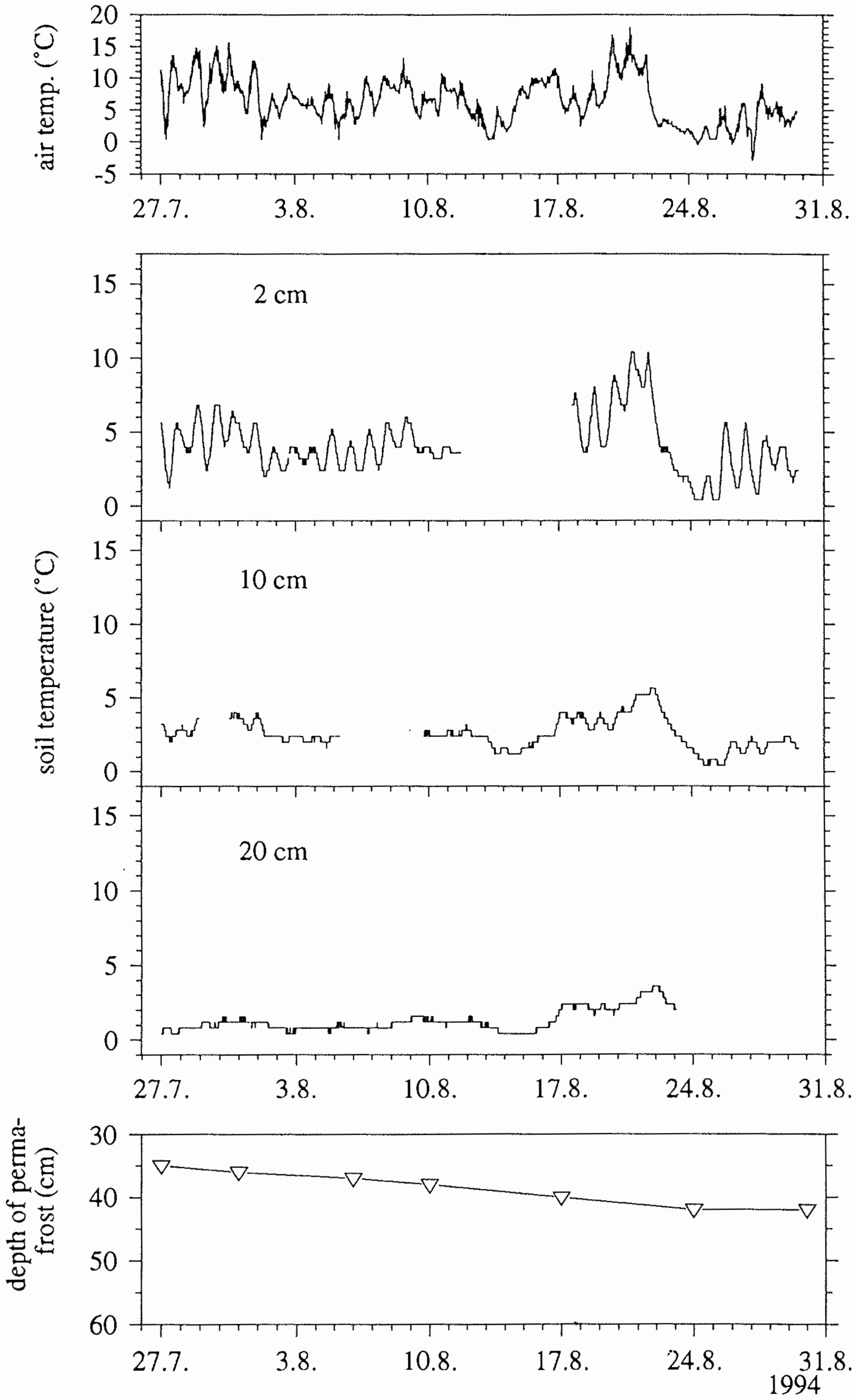


Figure 3.11: Ambient temperature, soil temperatures and depth of permafrost in humid tussock tundra, ice wedge.

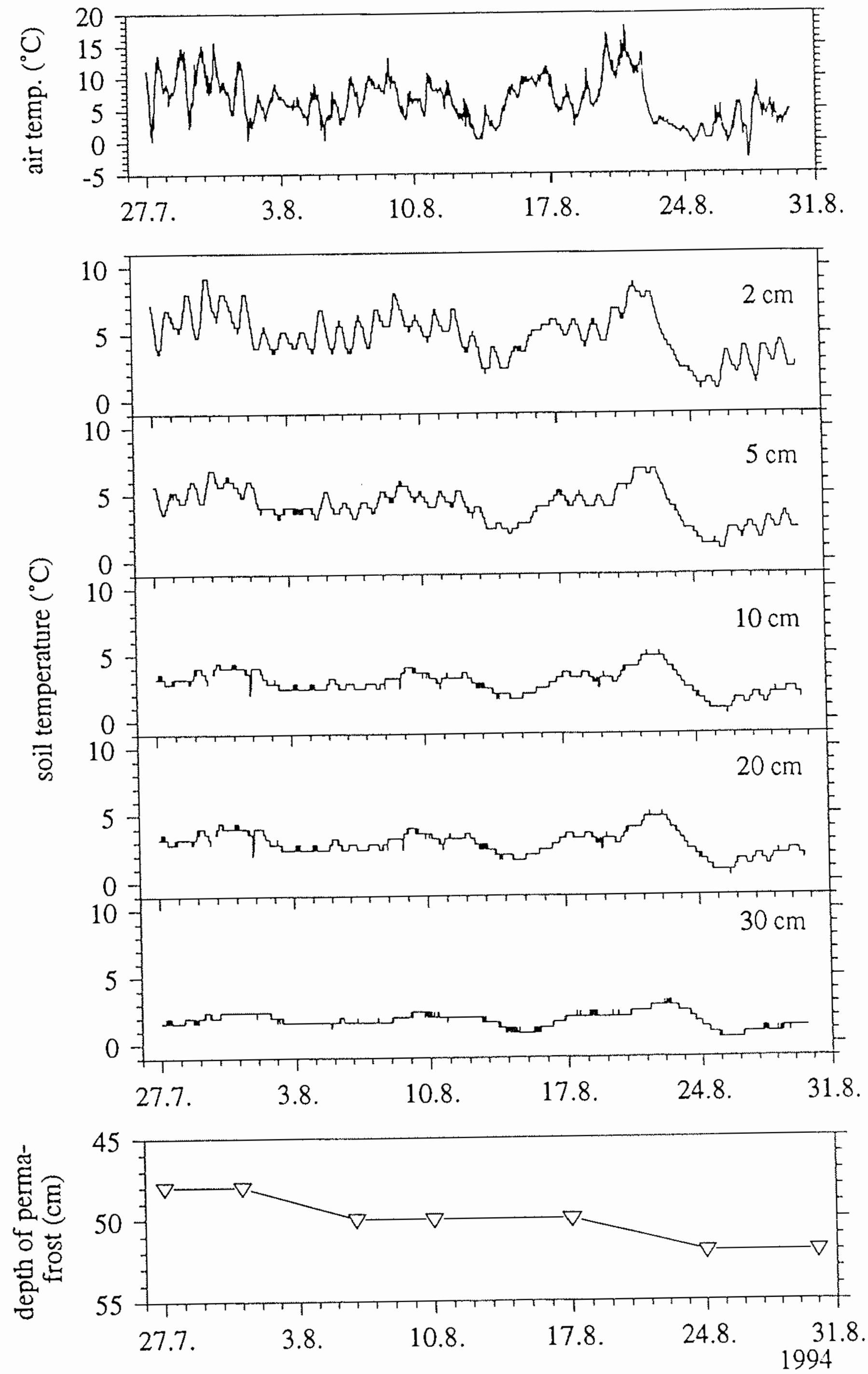


Figure 3.12: Ambient temperature, soil temperatures and depth of permafrost in wet sedge tundra.

3.3.4 Future Planning and Coordination with other Working Groups

The main task for research during the "Taymyr 1995" expedition will be the *in-situ* CO_2-turnover measurements for soil respiration and primary production. Extensive micro- and mesoclimatic measurements will also be carried out. Special emphasis will be given to the factor soil moisture. Additionally, measurements of nutrient potential and redox potential will be made. The SOM investigations of the Soil Science Institute, Hamburg will be combined with the investigations targeting the microbial community structure taking place in the laboratory in Kiel with image analysis equipment.

4. THE INTERNATIONAL TUNDRA EXPERIMENT (ITEX)

J.Boike and M. Sommerkorn

ITEX is an international field program with the aim to assess the effects of climatic change on the tundra ecosystem. Experimental and monitoring sites have been established in Arctic and alpine areas areas. In 1994, two new ITEX sites located on the Taymyr Peninsula at Levinson-Lessing and Labaz Lake were established. At these stations, late season active layer thaw depths were measured in a 100 x 100 km grid.

At Levinson-Lessing Lake, the ITEX site is located in proximity to the lake on the first terasse of the alluvial plain (for overview see Figure 2.10). It is characterized by low inclination and polygon structures with standing water conditions. Climate parameters (temperature, relative humidity, wind speed and direction, net radiation, precipitation) were recorded automatically every 20 secondes at Levinson-Lessing Lake from 22 July to 30 August (Table 4.1) at the automatic climate station located in the alluvial plain close to the Krasnaya River (see Figure 2.10). Active layer thaw depth data of 100 cells within the 100x100 m grid are summarized in Table 4.2.

At Labaz Lake, air temperature and humidity were recorded by means of a thermohydrograph in a screened weather hut within the camp site. The ITEX site is situated in a humid tussock tundra, which is the dominant vegetation/soil complex of the area (Figure 3.8). Air temperature was recorded with a shaded thermistor probe in 2 m height within the ITEX site from July 25 to August 29. Additionaly, soil temperatures were recorded in various depths of the active layer every 15 minutes (Figures 3. 10 and 3. 11). Depth of active layer was measured at 10 plots in a 100*100 m grid. At each plot four samples were taken within a square meter every week (Table 4.3). Average depth of active layer increased constantly during august to a maximum of 42,3 cm on August 24. Average ambient temperature of August was 5.9°C, maximum was 18, minimum was -2.8°C.

Table 4.1: Average daily climate data from the automatic weather station, Levinson-Lessing Lake, 1994

Date	Rel. humidity [%]	Air temp. [°C]	Net Irradiance [W/m²]	Wind speed [m/s]	Wind direction [360°=N]	Std.dev.	Precip. [mm]	Min.air temp. [°C]	Max.air temp. [°C]
24.07.1994	72.3	2.347		5.2	297.4	11.9	0	0	3.411
25.07.1994	81.9	2.524		6.712	336.8	11.43	1.584	0	3.824
26.07.1994	77.8	3.093		5.349	321.9	15.91	0	0.079	6.247
27.07.1994	76.7	6.69	49.79	2.77	314.3	44.13	0	3.185	10.57
28.07.1994	78.3	9.12	71.2	2.012	241.6	81.9	0	3.814	14.81
29.07.1994	73.2	9.76	76.7	2.194	334.2	36.5	0	6.237	13.28
30.07.1994	71.3	11.29	75.3	2.544	237.9	66.09	0.198	6.53	18.1
31.07.1994	84.5	7.33	33.78	5.618	306.6	42.63	2.97	3.015	15.45
01.08.1994	79.7	3.595	61.02	6.576	307	15.71	0	1.192	7.08
02.08.1994	79.7	3.084	59.2	6.379	306.6	13.53	0	1.172	5.501
03.08.1994	84	5.366	28	7.52	281.9	20.88	1.188	2.491	7.5
04.08.1994	81.5	2.149	54.69	3.184	330.8	21.14	0.198	0.705	3.449
05.08.1994	71.2	3.07	58.78	1.881	285.7	66.71	0	0.705	5.711
06.08.1994	81.4	3.406	46.14	3.748	304.6	28.35	0.198	1.472	5.312
07.08.1994	82.8	6.202	33.65	3.244	288.5	40.64	0.99	3.731	8.58
08.08.1994	83.6	7.08	28.86	4.159	184.2	61.84	0.198	2.325	9.7
09.08.1994	86	3.191	52.31	3.403	324.8	25.06	0	0.247	6.247
10.08.1994	79.3	4.513	59.93	3.753	315	32.97	0	0.592	7.76
11.08.1994	75.6	6.532	65.31	4.37	285.2	74.1	0	3.816	9.62
12.08.1994	74.6	5.599	55.43	5.425	246.1	48.09	3.168	1.819	8.75
13.08.1994	76.6	2.553	42.79	6.029	236.5	32.21	1.584	0.183	4.174
14.08.1994	79.3	1.616	47.68	5.607	302.3	16.94	0.198	-0.603	3.713
15.08.1994	83.1	3.761	19.79	6.013	288	26.3	0.396	1.249	7.08
16.08.1994	80.8	8.27	52.69	6.23	239.4	71.1	1.98	4.266	14.31
17.08.1994	86.7	3.523	33.16	3.181	343.8	19.27	1.782	2.009	5.272
18.08.1994	84.2	3.138	47.33	4.686	316.5	26.02	0.198	1.127	5.653
19.08.1994	81.7	3.37	46.88	2.748	309.1	67.14	23	0.914	6.569
20.08.1994	87.5	5.266	23.63	3.372	181.4	34.51	23	2.935	7.27

Date	Rel. humidity [%]	Air temp. [°C]	Net Irradiance [W/m²]	Wind speed [m/s]	Wind direction [360°=N]	Std.dev.	Precip. [mm]	Min.air temp. [°C]	Max.air temp. [°C]
21.08.1994	92.3	5.942	21.08	2.763	325.9	86.2	42	4.606	7.3
22.08.1994	86.3	4.662	20.76	5.365	78.8	52.14	6.534	3.406	5.577
23.08.1994	83.1	2.709	41.36	3.381	39.14	50.85	0	0.846	5.078
24.08.1994	77.7	2.727	30.42	4.194	19.17	35.86	0	-0.416	7.61
25.08.1994	87.1	0.983	39.97	2.946	280.5	77.5	0.594	-0.668	2.983
26.08.1994	81.5	1.786	45.15	1.39	190.8	51.03	0	-0.883	4.576
27.08.1994	73.3	3.645	38.42	2.588	188.2	36.37	0	2.147	5.879
28.08.1994	79	3.596	30.22	3.76	174.2	17.49	0	1.192	5.89
29.08.1994	81.4	3.41	26.71	2.599	282.7	60.69	0.198	1.135	5.578

Table 4.2: Thaw depth of active layer [cm], Levinson-Lessing Lake, 1994

	August 16, 1994					August 22, 1994					August 28, 1994				
Cell	north	east	south	west	average	north	east	south	west	average	north	east	south	west	average
1	-34.5	-32	-29.5	-29	-31.25	-35.5	-27.5	-29.5	-27	-29.88	-24.6	-28.2	-26.1	-27.1	-26.50
2	-34.5	-32.5	-31.5	-32.5	-32.75	-37.9	-36.5	-35.5	-35.7	-36.40	-33.3	-33.5	-33	-34	-33.45
3	-29.5	-28	-30	-32.7	-30.05	-35.3	-35.6	-34.1	-35.3	-35.08	-29.5	-34	-39.3	-32.5	-33.83
4	-29	-27	-30.7	-27	-28.425	-33.1	-32.5	-31.9	-31.9	-32.35	-32.5	-30.8	-28.6	-31.5	-30.85
5	-33.5	-36.8	-40	-36.5	-36.7	-36.7	-36	-35.8	-38.4	-36.73	-35.7	-37.5	-36.5	-37.5	-36.80
6	-39.5	-36.5	-40.5	-29	-36.375	-38.8	-40.5	-39.6	-35.6	-38.63	-42.5	-36.5	-33.7	-40.6	-38.33
7	-30	-33.5	-32.8	-31	-31.825	-38	-32.7	-36.1	-32.5	-34.83	-29.8	-32	-32.8	-31.6	-31.55
8	-28	-25	-27.5	-29	-27.375	-37.1	-24.1	-22.8	-36.6	-30.15	-28.3	-27.2	-26.3	-29.4	-27.80
9	-31	-30.5	-33	-32	-31.625	-36.4	-44.7	-37.5	-39.6	-39.55	-38	-33.1	-33.5	-32.4	-34.25
10	-28.5	-31.5	-23.5	-24	-26.875	-40.3	-35.3	-26.7	-40.2	-35.63	-31	-30.6	-32	-27.5	-30.28
11	-27.5	-32	-28.5	-30.5	-29.625	-30.6	-31.7	-32.8	-27.9	-30.75	-32.5	-25.7	-29	-26	-28.30
12	-33	-33.5	-30.5	-32	-32.25	-32.3	-37.2	-34	-35.7	-34.80	-35.5	-34	-34	-35	-34.63
13	-32.5	-33	-34.5	-32.5	-33.125	-35.7	-36.8	-44.5	-37.4	-38.60	-29	-31.5	-36	-26	-30.63
14	-30.5	-33.5	-33	-31.5	-32.125	-33.4	-33.9	-35.9	-32.9	-34.03	-30.2	-30.5	-29.5	-34	-31.05
15	-34.5	-30	-33	-30.5	-32	-38.9	-36.3	-35.3	-37.6	-37.03	-41.5	-33	-39	-38	-37.88
16	-27.5	-31	-27	-29	-28.625	-33.9	-22.3	-28.1	-27.7	-28.00	-28.5	-31.8	-25	-34	-29.83
17	-31.5	-27	-28	-33.5	-30	-30	-30	-30.1	-27.9	-29.50	-33.5	-32	-30	-30	-31.38
18	-32.5	-32	-33.5	-27.5	-31.375	-35.7	-32.4	-34.2	-34.2	-34.13	-34	-27	-30	-28.7	-29.93
19	-33.5	-37	-40.5	-38	-37.25	-35	-39.9	-40.5	-40.2	-38.90	-35.5	-31	-34	-32	-33.13
20	-37	-37.5	-33.5	-34.5	-35.625	-38.3	-37	-33.8	-39.9	-37.25	-32.5	-31	-29	-30	-30.63
21	-30.5	-34.5	-26	-29	-30	-40.3	-39.5	-42.1	-36.2	-39.53	-38	-38	-33	-36.5	-36.38
22	-33.5	-36.5	-35.5	-34.5	-35	-40.5	-31.2	-40.9	-40.8	-38.35	-34	-28.5	-29.5	-36.5	-32.13
23	-33.5	-33	-32.5	-31	-32.5	-33.1	-35.7	-32.7	-37.8	-34.83	-42.5	-41.5	-36.6	-37.5	-39.53
24	-31	-35	-38.5	-36	-35.125	-39.5	-31.4	-37.5	-34.5	-35.73	-37.5	-39	-33.6	-38.5	-37.15
25	-35	-31	-36.5	-35	-34.375	-29	-37	-31.8	-32.7	-32.63	-27.5	-30	-27.7	-29	-28.55
26	-32.5	-34	-35	-30	-32.875	-39	-42.8	-37.8	-36.7	-39.08	-30	-35	-33.5	-29.8	-32.08
27	-38.5	-35.5	-35	-34	-35.75	-35.8	-34.2	-32.6	-29.9	-33.13	-33	-27.5	-30.5	-34	-31.25
28	-33	-34	-34	-30.5	-32.875	-36.6	-34.4	-30.6	-34.6	-34.05	-27.5	-31.3	-33.5	-27.7	-30.00

Cell	August 16, 1994					August 22, 1994					August 28, 1994				
	north	east	south	west	average	north	east	south	west	average	north	east	south	west	average
29	-26.5	-27	-26.5	-30	-27.5	-34	-34	-33.9	-33.1	-33.75	-23.5	-33	-31	-27.4	-28.73
30	-29.5	-28.5	-27	-29	-28.5	-31.6	-32.5	-31.7	-30	-31.45	-33	-30	-33	-28	-31.00
31	-24	-29.5	-24.5	-23	-25.25	-34.9	-35	-34.5	-37.8	-35.55	-27	-30	-32.5	-33	-30.63
32	-30.5	-36.5	-30	-31.5	-32.125	-31	-31.7	-35.7	-33.3	-32.93	-30.5	-31.5	-35.5	-34	-32.88
33	-31.5	-32.5	-30.5	-29.5	-31	-32.7	-33.5	-32.4	-37.1	-33.93	-34	-46	-30	-36	-36.50
34	-31.5	-29	-27.5	-34.5	-30.625	-37.6	-38.2	-39.1	-35.5	-37.60	-42	-39	-35.5	-30.8	-36.83
35	-35.5	-36	-36.5	-34	-35.5	-37.3	-36.1	-36	-36.7	-36.53	-40.5	-35.5	-34	-36	-36.50
36	-35	-35.5	-40.5	-31.5	-35.625	-37.6	-42.8	-42.3	-31.7	-38.60	-36.7	-32	-35.3	-34	-34.50
37	-29.5	-32	-26	-36	-30.875	-26.8	-38.2	-34.9	-31.2	-32.78	-34.3	-34.3	-35.3	-31.3	-33.80
38	-32.5	-29	-34.5	-37	-33.25	-42.2	-33.9	-33.9	-32.5	-35.63	-34.5	-37	-36	-36.5	-36.00
39	-34	-32	-38.5	-37.5	-35.5	-45.5	-35.3	-32.6	-36.9	-37.58	-32.5	-33	-37	-37.5	-35.00
40	-31.5	-37.5	-36	-28	-33.25	-47.5	-47.4	-41.2	-41.5	-44.40	-33	-35.5	-37	-33	-34.63
41	-32.5	-33	-32	-31.5	-32.25	-33.3	-33.8	-34.2	-39.9	-35.30	-32.5	-40	-37	-40	-37.38
42	-30.5	-32.5	-35	-35	-33.25	-32.2	-30.9	-36	-37.7	-34.20	-38.5	-33.5	-35	-32.5	-34.88
43	-34	-36	-41.5	-38	-37.375	-34.9	-31.1	-39.8	-41.5	-36.83	-40	-34.7	-34	-35.5	-36.05
44	-24	-29.5	-31.5	-26	-27.75	-31.7	-26.3	-28.2	-31.1	-29.33	-32.5	-35.5	-37	-31.3	-34.08
45	-40	-38	-36.5	-35.5	-37.5	-45.5	-44.4	-40.1	-47.2	-44.30	-47	-38	-34.5	-37.8	-39.33
46	-31.5	-35	-39	-31.5	-34.25	-36.3	-35	-29.8	-32.6	-33.43	-32.5	-42.5	-32.5	-34	-35.38
47	-33.5	-32.5	-34	-30.2	-32.55	-37.7	-34.9	-44.7	-32	-37.33	-35.5	-34	-38.5	-35	-35.75
48	-36.5	-31	-34	-26.5	-32	-32.1	-35.3	-32.4	-31.7	-32.88	-38.5	-33.5	-32.5	-39.7	-36.05
49	-32	-33.5	-30.7	-26.1	-30.575	-29.2	-33.8	-40.8	-25.9	-32.43	-31	-35	-35	-34.5	-33.88
50	-38	-34	-40.7	-36	-37.175	-42.6	-35.8	-41.8	-34.7	-38.73	-50	-40	-50	-46.5	-46.63
51	-36	-40	-43.3	-35.5	-38.7	-32.2	-31.2	-35.6	-31.6	-32.65	-36.5	-35	-33.5	-37	-35.50
52	-38	-38.5	-41.2	-41.7	-39.85	-34.4	-28.8	-28.2	-27.7	-29.78	-33	-32.5	-31.5	-35	-33.00
53	-32.5	-35	-33	-30.5	-32.75	-35.4	-35.6	-27.1	-31.3	-32.35	-35	-27.5	-31	-39.5	-33.25
54	-31.2	-31	-34	-32.5	-32.175	-32.8	-35.8	-32.4	-49.2	-37.55	-27	-31.5	-30	-28	-29.13
55	-27.5	-30	-39	-32.5	-32.25	-42.4	-35.5	-37.3	-35.7	-37.73	-39	-40	-42	-41.5	-40.63
56	-29.5	-32	-35.5	-31	-32	-31.6	-37.8	-33.2	-36.4	-34.75	-37	-36	-36.5	-34.5	-36.00
57	-33.5	-35	-35	-28.5	-33	-41.9	-39.7	-40	-41.2	-40.70	-31.7	-33.7	-41.5	-48.5	-38.85
58	-37.5	-37.2	-35.5	-40.2	-37.6	-28.5	-32.5	-42.4	-36	-34.85	-34.5	-33.7	-37.5	-35	-35.18

Cell	August 16, 1994					August 22, 1994					August 28, 1994				
	north	east	south	west	average	north	east	south	west	average	north	east	south	west	average
59	-34	-36	-36	-34	-35	-36	-38.4	-35.8	-40.7	-37.73	-37	-37	-44.2	-36.7	-38.73
60	-43	-44.5	-35	-47.5	-42.5	-40.1	-39.9	-49.7	-47.8	-44.38	-34	-38	-34.5	-39.5	-36.50
61	-35	-30.5	-30.5	-30.5	-31.625	-31.8	-32.7	-39	-34	-34.38	-27.5	-39	-31.8	-27.7	-31.50
62	-24	-25	-28	-30.5	-26.875	-31.9	-26.2	-30.5	-30.7	-29.83	-46	-45	-37.6	-44.5	-43.28
63	-33	-34	-35.5	-34	-34.125	-29.1	-35.9	-35.5	-35.1	-33.90	-35.5	-34.5	-32	-33.5	-33.88
64	-33.5	-38.3	-34	-34.5	-35.075	-34	-40.6	-48.5	-33.9	-39.25	-38.5	-38.5	-37.7	-35.2	-37.48
65	-28.5	-31.5	-30	-30	-30	-33.5	-30.4	-30	-32.4	-31.58	-35.7	-36	-34.5	-34.7	-35.23
66	-38	-38.5	-35	-38.5	-37.5	-34.5	-36.5	-39.4	-41.2	-37.90	-37	-35.1	-34.5	-34.7	-35.33
67	-25	-45.5	-47	-44.5	-40.5	-41.1	-41.6	-46.1	-47.4	-44.05	-37.4	-39.7	-40	-38.2	-38.83
68	-28.5	-33	-28.2	-28.2	-29.475	-29.6	-35.5	-35.1	-32.7	-33.23	-34.2	-34.6	-33.5	-34	-34.08
69	-41.5	-41	-38	-40.5	-40.25	-42.5	-44.6	-39.6	-43.5	-42.55	-31.5	-33	-34.7	-32.7	-32.98
70	-39.5	-37	-33.5	-40.5	-37.625	-38.8	-43.9	-36.5	-41.5	-40.18	-34.5	-37.7	-37.3	-40	-37.38
71	-30	-28	-28	-34	-30	-39.3	-30.9	-25.8	-32.1	-32.03	-32	-37	-36.3	-32.6	-34.48
72	-42	-35	-36	-38.5	-37.875	-40.2	-37.8	-42.7	-37.6	-39.58	-39.7	-38	-36.2	-39.6	-38.38
73	-34	-30	-34	-29.5	-31.875	-37.5	-33.5	-33.5	-31.7	-34.05	-44.5	-37.6	-34.5	-44.5	-40.28
74	-32.5	-32.5	-33.5	-34	-33.125	-35.6	-31	-38.4	-36.5	-35.38	-36.5	-35.5	-36.7	-33.7	-35.60
75	-30.5	-32	-32.5	-30	-31.25	-31.7	-30.8	-31.4	-31.2	-31.28	-37.5	-36.5	-35.8	-30	-34.95
76	-31.5	-34.5	-29	-26.5	-30.375	-37.5	-42.3	-38.5	-37.7	-39.00	-28.5	-34	-33	-32.5	-32.00
77	-31.5	-42.5	-30	-28	-33	-37.7	-36.1	-34.8	-29.6	-34.55	-40.2	-41.2	-43.1	-43.5	-42.00
78	-32.5	-41	-34.5	-32.5	-35.125	-33.7	-33.4	-36.9	-34.2	-34.55	-35.2	-33.7	-32.8	-32	-33.43
79	-32.8	-35	-33.5	-39.5	-35.2	-39.4	-34.6	-34.2	-35.6	-35.95	-33.7	-37	-37.7	-42	-37.60
80	-26	-27.5	-30	-30.5	-28.5	-33.3	-31.1	-36.2	-29.1	-32.43	-42.5	-35.1	-35.5	-32	-36.28
81	-34.5	-31	-37.5	-38.5	-35.375	-38.5	-35.6	-41.2	-42	-39.33	-36.5	-29.8	-31.7	-36.2	-33.55
82	-36.5	-27.5	-35	-35.5	-33.625	-31.9	-35.8	-36.1	-34.5	-34.58	-33.5	-40	-37	-37.2	-36.93
83	-43.5	-34	-35	-36	-37.125	-33.5	-36	-34.5	-35.2	-34.80	-40.7	-36.5	-35	-38	-37.55
84	-28	-33.5	-33.7	-29.5	-31.175	-34.1	-41.2	-30.8	-27.2	-33.33	-38	-41	-32	64	-11.75
85	-39	-45.2	-48.5	-44	-44.175	-26.9	-32.5	-35.2	-31.8	-31.60	-28.3	-32.7	-31.2	67.7	-6.13
86	-35	-36.5	-31	-32	-33.625	-37	-37.5	-36.1	-33.1	-35.93	-35.2	-32.2	-32	63	-9.10
87	-39.8	-37.5	-38	-33.5	-37.2	-40.1	-36.5	-38.7	-35.7	-37.75	-41.2	-33.7	-33.6	62.9	-11.40
88	-33.5	-40	-40.3	-36.5	-37.575	-42.8	-35.9	-35.1	-42.4	-39.05	-40.5	-30.7	-37	72.3	-8.98

Cell	August 16, 1994 north	east	south	west	average	August 22, 1994 north	east	south	west	average	August 28, 1994 north	east	south	west	average
89	-33	-34.3	-34.5	-34.2	-34	-38	-38.5	-41.6	-43.3	-40.35	-39.2	-32.8	-29.4	62	-9.85
90	-31.5	-34	-33	-33.3	-32.95	-34.4	-36.2	-38	-35.8	-36.10	-39	-31.5	-26.5	71.5	-6.38
91	-36	-37	-37	-38.5	-37.125	-39.7	-39.6	-49.5	-50.6	-44.85	-40.3	-43.7	-35.5	-39.7	-39.80
92	-41	-39.5	-39.5	-37.3	-39.325	-50.3	-43.1	-40.1	-46.5	-45.00	-34.5	-34.6	-37.5	-39.7	-36.58
93	-44.5	-42	-41.5	-38	-41.5	-40.2	-48.5	-42.1	-46.7	-44.38	-37	-41.8	-44.7	-43.7	-41.80
94	-34.8	-34.5	-34.5	-44.2	-37	-36.5	-38.5	-40.2	-36.1	-37.83	-35.5	-37.5	-39.7	-37.7	-37.60
95	-42	-41	-36	-40.5	-39.875	-34.6	-38.5	-37.7	-39.1	-37.48	-38	-40.2	-42.3	-40.8	-40.33
96	-32.8	-34.5	-33.9	-31.5	-33.175	-40.3	-39	-42.2	-35.6	-39.28	-34	-35.5	-37	-35.5	-35.50
97	-33.5	-35.9	-36.5	-37	-35.725	-36.1	-39.6	-37	-38.3	-37.75	-42.2	-39.7	-33.7	-40.3	-38.98
98	-36.5	-36	-32.5	-34	-34.75	-32.6	-31.1	-32.5	-35.6	-32.95	-32	-31.3	-33.7	-37.7	-33.68
99	-33.5	-35.5	-28.5	-30	-31.875	-27.2	-28.7	-30.7	-39	-31.40	-32.7	-29.5	-28.2	-30.7	-30.28
100	-36.5	-38.2	-40	-38.5	-38.3	-38.4	-34.8	-33.8	-39	-36.50	-29.5	-32.5	-27	-30.7	-29.93
		Average			**-33.68**					**-35.93**					**-33.02**

Table 4.3: Active layer thaw depth [cm], Labaz Lake, 1994

		July 29	Aug 03	Aug 10	Aug 17	Aug 24
1	N	34	40	40	40	41
1	E	51	53	53	52	53
1	S	39	43	44	44	44
1	W	43	40	41	40	40
2	N	47	42	43	44	45
2	E	32	35	34	38	40
2	S	38	38	41	43	44
2	W	42	43	43	45	45
3	N	39	40	43	41	43
3	E	39	37	40	40	40
3	S	49	47	49	49	50
3	W	34	34	37	38	40
4	N	47	44	46	45	47
4	E	40	39	39	39	39
4	S	32	29	32	32	34
4	W	30	30	35	32	34
5	N	47	32	37	38	37
5	E	31	37	37	36	39
5	S	28	27	28	31	32
5	W	35	27	33	29	31
6	N	41	42	44	43	45
6	E	41	41	43	44	43
6	S	38	37	40	39	39
6	W	32	34	37	35	35
7	N	43	43	45	45	48
7	E	46	40	45	47	45
7	S	38	37	41	38	39
7	W	30	28	33	31	36
8	N	38	40	40	41	42
8	E	40	42	42	42	44
8	S	39	42	40	43	43
8	W	39	38	39	38	43
9	N	45	49	50	49	48
9	E	42	44	45	44	45
9	S	42	44	46	45	46
9	W	42	46	45	45	48
10	N	41	39	42	45	46
10	E	38	44	39	45	47
10	S	39	46	47	47	49
10	W	43	43	47	47	48
Average		**39,35**	**39,40**	**41,13**	**41,23**	**42,43**

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7. APPENDIX

7.1 Water samples collected in the Levinson-Lessing basin in 1994.

Nr.	Date	Sample	pH	µS / cm	Isotopes	Tritium	Cations/Anions
1	27. Jul 94	1 B SOIL 1	6,80	239	X		
2	29. Jul 94	1 B SOIL 1	7,08	237	X	X	X
3	30. Jul 94	1 B SOIL 1	7,15	238	X		X
4	29. Jul 94	1 B SOIL 2	7,01	219	X	X	
5	30. Jul 94	1 B SOIL 2	7,32	222	X		
6	27. Jul 94	1 B SOIL 3	7,32	238	X		
7	29. Jul 94	1 B SOIL 3	7,17	260	X	X	
8	30. Jul 94	1 B SOIL 3	7,16	261	X		X
9	30. Jul 94	1 B WELL 2	7,11	334	X	X	
10	27. Jul 94	1 C SOIL 1	7,16	246	X		
11	29. Jul 94	1 C SOIL 1	7,28	250	X	X	
12	30. Jul 94	1 C SOIL 1	7,02	251	X	X	
13	30. Jul 94	1 C SOIL 2	7,00	225	X	X	
14	29. Jul 94	1 C SOIL 3	7,16	193	X		X
15	30. Jul 94	1 C SOIL 3	7,17	209	X	X	
16	30. Jul 94	2 A SOIL 3	7,20	336	X	X(10 ml)	
17	27. Jul 94	1 B SOIL 2			X		X
18	29. Jun 94	SNOW			X	X	XXX
19	29. Jun 94	SNOW (1-5)			X	X	XXX
20	29. Jun 94	SNOW (1-4)			X	X	XX
21	21. Jun 94	SNOW (1-6)			X		XXX
22	02. Aug 94	PRECIPITATION			XX	X	
23	29. Jul 94	1 C SOIL 2			X		
24	30. Jul 94	2 A SOIL 2			X		
25	29. Jul 94	1 A SOIL 2			X		
26	29. Jul 94	1 A SOIL 3			X		
27	30. Jul 94	PRECIPITATION			X	X	
28	30. Jul 94	1 A SOIL 2			X(10ml)		
29	30. Jul 94	1 C W 2			X		
30	30. Jul 94	1 A SOIL 3			X(10ml)		
31	02. Aug 94	PRECIPITATION			X	X	X
32	03. Aug 94	1 A SOIL 2			X		
33	03. Aug 94	1 A SOIL 3			X		
34	03. Aug 94	1 B SOIL 1	7,4	244	X	X	
35	03. Aug 94	1 B SOIL 3	7,34	274	X	X	
36	03. Aug 94	1 C SOIL 1	7,2	255	X	X	X
37	03. Aug 94	1 C SOIL 2	7,37	234	X	X	
38	03. Aug 94	1 C SOIL 3			X	X	
39	03. Aug 94	2 A SOIL 2			X	X	
40	03. Aug 94	2 B SOIL 1	7,61	-	X	X	
41	03. Aug 94	2 B SOIL 2	7,34	367	X	X	
42	03. Aug 94	2 C SOIL 1	7,49	473	X	X	
43	03. Aug 94	2 C SOIL 3	7,43	402	X	X	
44	03. Aug 94	2 D SOIL 1	7,21	468	X	X	
45	03. Aug 94	2 D SOIL 3	7,03	662	X	X	
46	04. Aug 94	PRECIPITATION			X		

Nr.	Date	Sample	pH	µS / cm	Isotopes	Tritium	Cations/Anions
47	04. Aug 94	LAKE	6,64	550			
48	04. Aug 94	PIEZO	6,72	89,3			
49	04. Aug 94	PIEZO	6,64	98,7			
50	05. Aug 94	LAKE	6,5	167,5			
51	07. Aug 94	PRECIPITATION	6,6	38	X	X	X
52	07. Aug 94	1 A SOIL 2			X(10ml)		
53	07. Aug 94	1 A SOIL 3			X(10ml)		
54	07. Aug 94	1 B SOIL 1	6,44	242	X		
55	07. Aug 94	1 B SOIL 2	7,25	224	X		
56	07. Aug 94	1 B SOIL 3	7,09	246	X		
57	07. Aug 94	1 B WELL			X		
58	07. Aug 94	1 C SOIL 1	7,11	258	X		
59	07. Aug 94	1 C SOIL 2	7,08	236	X		
60	07. Aug 94	1 C SOIL 3	7,06	228	X		
61	07. Aug 94	1 C WELL 1	6,64	262	X		
62	07. Aug 94	2 A SOIL 1	7,35	336	X		
63	07. Aug 94	2 A SOIL 2			X		
64	07. Aug 94	2 A SOIL 3			X (10ml)		
65	07. Aug 94	2 A W	7,24	279	X		
66	07. Aug 94	2 B SOIL 1	7,52	432	X		
67	07. Aug 94	2 B SOIL 2	7,62	357	X		
68	07. Aug 94	2 B WELL	7,18	407	X		
69	07. Aug 94	2 C SOIL 1	7,63	445	X		
70	07. Aug 94	2 C SOIL 2	7,7	400	X		
71	07. Aug 94	2 C SOIL 3	7,82	385	X		
72	07. Aug 94	2 C WELL	7,23	441	X		
73	07. Aug 94	2 D SOIL 1	7,55	467	X		
74	07. Aug 94	2 D SOIL 2	7,96	632	X		
75	07. Aug 94	2 D SOIL 3	7,48	664	X		
76	07. Aug 94	3 A SOIL 1	7,45	115	X		
77	07. Aug 94	3 A SOIL 2	7,01	73	X		
78	07. Aug 94	3 A WELL		126	X		
79	07. Aug 94	3 B SOIL 1	6,61	216	X		
80	07. Aug 94	3 B SOIL 2	6,73	128	X		
81	07. Aug 94	3 B WELL	6,94	140	X		
82	07. Aug 94	3 C SOIL 1	6,63	130	X		
83	07. Aug 94	3 C SOIL 2	6,61	118	X		
84	07. Aug 94	3 C WELL	6,9	135	X		
85	07. Aug 94	3 D SOIL 1	6,68	107	X		
86	07. Aug 94	3 D WELL		63	X		
87	07. Aug 94	3 F SOIL 1	6,67	80	X		
88	07. Aug 94	3 E SOIL 1	6,7	93	X		
89	07. Aug 94	2 D WELL	6,9	516			
90	29. Jul 94	1 B SOIL 3	6,47	251			
91	30. Jul 94	1 C WELL 2	6,6	257			
92	29. Jul 94	1 C SOIL 2	6,68	183,2			
93	12. Aug 94	1 A SOIL 2					
94	12. Aug 94	1 A SOIL 3					

Nr.	Date	Sample	pH	µS / cm	Isotopes	Tritium	Cations/Anions
95	12. Aug 94	1 B WELL 2	6,7	132			
96	12. Aug 94	1 B SOIL 1	6,77	241	X	X	
97	12. Aug 94	1 B SOIL 2	6,84	222			
98	12. Aug 94	1 B SOIL 3			X		
99	12. Aug 94	1 C SOIL 0			X		
100	12. Aug 94	1 C SOIL 1	6,79	252	X		
101	12. Aug 94	1 C SOIL 2	6,34	233	X	X	
102	12. Aug 94	1 C SOIL 3	6,54	233	X	X	
103	12. Aug 94	1 C WELL 1	6,56	278	X	X	
104	12. Aug 94	1 C PIEZO 1	6,67	276			
105	12. Aug 94	2 A SOIL 1	7,5	343	X	X	
106	12. Aug 94	2 A SOIL 2			X		
107	12. Aug 94	2 A WELL	7,48	284	X	X	
108	12. Aug 94	2 B WELL	6,43	490	X	X	
109	12. Aug 94	2 B SOIL 1	6,96	426	X	X	
110	12. Aug 94	2 B SOIL 2	7,32	355	X	X	
111	12. Aug 94	2 C WELL	7,29	460	X		
112	12. Aug 94	2 C SOIL 1	7,35	439	X	X	
113	12. Aug 94	2 C SOIL 2	7,49	400	X	X	
114	12. Aug 94	2 D WELL	7,31	522	X	X	
115	12. Aug 94	2 D SOIL 1	7,46	461	X		
116	12. Aug 94	2 D SOIL 2	7,39	627	X		
117	12. Aug 94	2 D SOIL 3	7,33	657	X		
118	12. Aug 94	2 D PIEZO 1	7,41	540	X	X	
119	12. Aug 94	2 D PIEZO 2	7,36	682			
120	12. Aug 94	PRECIP. 20:00	7,23	6,1	X		
121	13. Aug 94	PRECIP. 12:00	6,76	5	X		
122	12. Aug 94	CORE 3 0-10			X		
123	12. Aug 94	CORE 3 22-10			X		
124	12. Aug 94	CORE 3 39-22			X	X	
125	12. Aug 94	CORE 3 47-39			X		
126	12. Aug 94	CORE 3 56-47			X		
127	12. Aug 94	CORE 3 68-56			X		
128	12. Aug 94	CORE 3 80-68			X		
129	13. Aug 94	3 A WELL	5,92	118,1	X	X	
130	13. Aug 94	3 A PIEZO 1	6,32	99,8			
131	13. Aug 94	3 A PIEZO 2	6,21	126,2	X		
132	13. Aug 94	3 A SOIL 1	6,17	125,9	X	X	
133	13. Aug 94	3 A SOIL 2	6,35	75,6	X	X	
134	13. Aug 94	3 B WELL	6,18	137,3	X	X	
135	13. Aug 94	3 B SOIL 1	6,16	218	X	X	
136	13. Aug 94	3 B SOIL 2	6,27	137,3	X	X	
137	13. Aug 94	3 C WELL	6,27	148,2	X	X	
138	13. Aug 94	3 C SOIL 1	6,34	133,4	X	X	
139	13. Aug 94	3 C SOIL 2	6,25	130,6	X	X	
140	13. Aug 94	3 D WELL	6,44	70,6			
141	13. Aug 94	3 D PIEZO	6,44	98,6			
142	13. Aug 94	3 D SOIL 1	6,46	113,9	X	X	

Nr.	Date	Sample	pH	µS / cm	Isotopes	Tritium	Cations/Anions
143	13. Aug 94	3 E SOIL 1	6,44	106	X	X	
144	13. Aug 94	3 F SOIL 1	6,52	93,6	X	X	
145	13. Aug 94	3 G PIEZO 1	6,56	121,8			
146	13. Aug 94	3 H WELL	6,44	156,4	X		
147	13. Aug 94	3 H PIEZO 1	6,39	218			
148	13. Aug 94	3 H PIEZO 2	6,53	115,9			
149	15. Aug 94	PRECIP. 01:00	6,14	6,7	X	X	
150	20. Aug 94	PRECIP. 16:30	5,73	9,9	X	X	
151	20. Aug 94	1 A SOIL 2			X		
152	20. Aug 94	1 A SOIL 3			X		
153	20. Aug 94	1 X WELL	6,37	226	X		
154	20. Aug 94	1 X SOIL 1	6,92	257	X		
155	20. Aug 94	1 X SOIL 3			X		
156	20. Aug 94	1 B WELL 2	6,97	94,1	X		
157	20. Aug 94	1 B SOIL 1	6,74	225	X		
158	20. Aug 94	1 B SOIL 2	7,03	208	X		
159	20. Aug 94	1 C WELL 1	6,83	264	X		
160	20. Aug 94	1 C SOIL 1	6,82	238	X		
161	20. Aug 94	1 C SOIL 2	6,37	233	X		
162	20. Aug 94	1 C SOIL 3	6,56	239	X		
163	20. Aug 94	2 A WELL	6,72	278	X		
164	20. Aug 94	2 A SOIL 1	7,42	316	X		
165	20. Aug 94	2 A SOIL 2			X		
166	20. Aug 94	2 B WELL	7,24	326	X		
167	20. Aug 94	2 B SOIL 1	7,61	405	X		
168	20. Aug 94	2 B SOIL 2	7,67	338	X		
169	20. Aug 94	2 C WELL	7,58	446	X		
170	20. Aug 94	2 C SOIL 1	7,62	378	X		
171	20. Aug 94	2 C SOIL 3 18:00	7,79	349	X		
172	20. Aug 94	2 D W 17:00	7,48	507	X		
173	20. Aug 94	2 D SOIL 1	7,49	438	X		
174	20. Aug 94	2 D SOIL 3	7,25	640	X		
175	20. Aug 94	2 C SOIL 1 23:00	7,72	420	X		
176	20. Aug 94	2 C SOIL 2 23:00			X		
177	20. Aug 94	2 C SOIL 3 23:00			X		
178	20. Aug 94	2 D SOIL 1 23:00	7,69	439	X		
179	20. Aug 94	2 D SOIL 3 23:00	7,79	636	X		
180	21. Aug 94	3 A SOIL 1	7,36	126,9	X	X	
181	21. Aug 94	3 A SOIL 2	7,28	78,9	X	X	
182	21. Aug 94	3 A WELL	7	118,2	X		
183	21. Aug 94	3 B WELL	6,83	135,1	X	X	
184	21. Aug 94	3 B SOIL 2	6,8	132	X	X	
185	21. Aug 94	3 B SOIL 1	6,52	186,4	X	X	
186	21. Aug 94	3 C WELL	6,73	133,1	X	X	
187	21. Aug 94	3 C SOIL 1	6,69	133,6	X	X	
188	21. Aug 94	3 C SOIL 2	6,62	139,6	X	X	
189	21. Aug 94	3 D WELL			X		
190	21. Aug 94	3 D SOIL 3	6,83	109,4	X	X	

Nr.	Date	Sample	pH	µS / cm	Isotopes	Tritium	Cations/Anions
191	21. Aug 94	2 E SOIL 1	6,78	110,2	X	X	
192	21. Aug 94	3 F SOIL 1	6,72	110,9	X	X	
193	21. Aug 94	3 H WELL			X		
194	22. Aug 94	PRECP. 12:30	6,85		X	X	
195	21. Aug 94	2 C SOIL 1	7,29	422	X		
196	21. Aug 94	2 C SOIL2	7,56	386	X		
197	22. Aug 94	2 C SOIL3			X		
198	23. Aug 94	2 A SOIL 1			X		
199	23. Aug 94	2 X SOIL 1			X		
200	23. Aug 94	2 X SOIL 2			X		
201	23. Aug 94	2 X SOIL 3			X		
202	23. Aug 94	2 X SOIL 5			X		
203	23. Aug 94	2 C SOIL 1			X		
204	23. Aug 94	2 C SOIL 2			X		
205	23. Aug 94	2 C SOIL 3			X		
206	23. Aug 94	2 C SOIL 1			X		
207	23. Aug 94	2 C SOIL 2			X		
208	23. Aug 94	2 D SOIL 1			X		
209	23. Aug 94	2 D SOIL 2			X		
210	23. Aug 94	2 D SOIL 3			X		
211	26. Aug 94	2 D SOIL 1	7,36	455	X	X	
212	26. Aug 94	2 D SOIL 2	7,69	589	X	X	
213	26. Aug 94	2 D SOIL 3			X	X	
214	26. Aug 94	2 D PIEZO	7,66	520	X	X	
215	26. Aug 94	2 D PIEZO	7,49	623	X	X	X
216	26. Aug 94	2 D WELL	7,35	551	X	X	X
217	26. Aug 94	2 A WELL	7,56	295	X	X	X
218	26. Aug 94	2 A SOIL 3			X		X(10 ml)
219	26. Aug 94	2 A SOIL 1			X		
220	26. Aug 94	2 B SOIL 1	7,58	422	X	X	
221	26. Aug 94	2 B SOIL 2	7,96	360	X		
222	26. Aug 94	2 B WELL	7,93	345	X	X	
223	26. Aug 94	2 B PIEZO 2			X		
224	26. Aug 94	2 B PIEZO 1	7,8	257	X		X(10 ml)
225	26. Aug 94	2 C SOIL 1	7,7	436	X	X	
226	26. Aug 94	2 C SOIL 2	7,64	435	X	X	
227	26. Aug 94	2 C SOIL 3	7,71	387	X	X	
228	26. Aug 94	2 C WELL	7,8	410			
229	26. Aug 94	2 C PIEZO 1			X		
230	26. Aug 94	2 C PIEZO2			X		
231	26. Aug 94	2 X SOIL 1	7,59	1110	X	X	
232	26. Aug 94	2 X SOIL 2	7,6	1049	X	X	
233	26. Aug 94	2 X SOIL 3	7,68	788	X	X	
234	26. Aug 94	2 X SOIL 4	7,62	629	X	X	
235	26. Aug 94	2 X SOIL 5	7,69	536	X	X	
236	26. Aug 94	2 X PIEZO1			X		X(10 ml)
237	26. Aug 94	2 X PIEZO 2	7,58	535	X		
238	26. Aug 94	2 X WELL	7,46	814	X		

Nr.	Date	Sample	pH	µS / cm	Isotopes	Tritium	Cations/Anions
239	26. Aug 94	1 B SOIL 1			X		
240	26. Aug 94	1 B SOIL 2			X		
241	26. Aug 94	1 B SOIL 3			X		
242	26. Aug 94	1 B PIEZO 2			X		
243	26. Aug 94	1 B PIEZO 1					
244	26. Aug 94	1 B WELL 2		193,5	X	X	
245	26. Aug 94	1 A SOIL 1			X		
246	26. Aug 94	1 C SOIL 1			X		
247	26. Aug 94	1 C SOIL 2			X		
248	26. Aug 94	1 C SOIL 3			X		
249	26. Aug 94	1 C PIEZO 1			X		X(10ml)
250	26. Aug 94	1 C PIEZO 2			X		
251	26. Aug 94	1 C WELL 1	7,35	232	X	X	
252	26. Aug 94	1 C WELL 2	7,24	297			
253	26. Aug 94	1 X SOIL 1	7,77	268	X		
254	26. Aug 94	1 X SOIL 3	7,77	194,4	X		
255	26. Aug 94	1 X PIEZO 1			X		
256	26. Aug 94	1 X PIEZO 2			X		
257	28. Aug 93	1 X WELL		199,8	X	X	
258	27. Aug 94	3 A WELL	5,59	133,1	X	X	
259	27. Aug 94	3 A PIEZO 2			X		
260	27. Aug 94	3 A SOIL 1	5,82	137,4	X	X	
261	27. Aug 94	3 A SOIL 2	5,93	78,1	X	X	
262	27. Aug 94	3 B WELL	5,9	129,7	X	X	
263	27. Aug 94	3 B PIZO 1			X		
264	27. Aug 94	3 B PIEZO 2			X		
265	27. Aug 94	3 B SOIL 1	5,87	206	X	X	
266	27. Aug 94	3 B SOIL 2	6,04	170,9	X	X	
267	27. Aug 94	3 C WELL	6	169,8	X	X	
268	27. Aug 94	3 C PIEZO 1			X		
269	27. Aug 94	3 C SOIL 1	6,26	143,6	X	X	
270	27. Aug 94	3 C SOIL 2	6,22	144,3	X	X	
271	27. Aug 94	3 A PIEZO 1			X		
272	27. Aug 94	3 D WELL	6,12	127,8	X	X	
273	27. Aug 94	3 D PIEZO 1			X		
274	27. Aug 94	3 D SOIL 1	6,23	115,9	X	X	
275	27. Aug 94	3 E WELL	6,21	115,4	X		
276	27. Aug 94	3 E PIEZO 1			X		
277	27. Aug 94	3 E SOIL 1	6,18		X	X	
278	27. Aug 94	3 F SOIL 1	6,06	112,3	X	X	
279	27. Aug 94	3 H WELL	6,66	126,2	X		
280	27. Aug 94	3 H PIEZO 1	6,37	123,2	X		
281	27. Aug 94	3 H PIEZO 2	6,44	214	X		
282	27. Aug 94	3 J WELL	6,11	93	X	X	
283	27. Aug 94	3 J PIEZO 1		106,6	X		
284	27. Aug 94	3 J PIEZO 2			X		
285	27. Aug 94	Lake Piezo 2	5,5	88			
286	27. Aug 94	Lake Piezo 4	5,91	146,7			

Nr.	Date	Sample	pH	µS / cm	Isotopes	Tritium	Cations/Anions
287	23. Aug 94	2 B SOIL 1	6,82	430			
288	23. Aug 94	2 B SOIL 2	7,16	363			
289	28. Aug 94	1 A SOIL 2	7,02	163,9			
290	28. Aug 94	1 A SOIL 3	7,12	114,2			
291	28. Aug 94	1 X SOIL1	7,08	243			
292	28. Aug 94	1 X SOIL 2	7,2	222			
293	28. Aug 94	1 X SOIL 3	7,25	182			
294	28. Aug 94	1 X WELL	6,82	213			
295	28. Aug 94	1 X PIEZO 1	7,25	253			
296	28. Aug 94	1 B SOIL1	6,95	248			
297	28. Aug 94	1 B SOIL 2	7,02	242			
298	28. Aug 94	1 B WELL 1	6,97	177			
299	28. Aug 94	1 B WELL 2	7,09	197			
300	28. Aug 94	1 B PIEZO 1	7,12	252			
301	28. Aug 94	1 B PIEZO 2	7,13	170			
302	28. Aug 94	1 C SOIL 0	8,04	387			
304	28. Aug 94	1 C SOIL 1	7,53	264			
305	28. Aug 94	1 C SOIL 2	7,39	248			
306	28. Aug 94	1 C SOIL 3	7,29	261			
307	28. Aug 94	1 C WELL 1	7,06	324			
308	28. Aug 94	1C WELL 2	7,07	282			
309	28. Aug 94	2 A SOIL 1	7,25	329			
310	28. Aug 94	2 A SOIL 2	7,87	292			
311	28. Aug 94	2 A SOIL 3	7,86	288			
312	28. Aug 94	2 A WELL	7,7	289			
313	28. Aug 94	2 B SOIL 1	7,7	389			
314	28. Aug 94	2 B SOIL 2	7,77	357			
315	28. Aug 94	2 B SOIL 3	7,9	330			
316	28. Aug 94	2 B WELL	7,79	385			
317	28. Aug 94	2 B PIEZO 1	7,81	354			
318	28. Aug 94	2 C SOIL 1	7,69	493			
319	28. Aug 94	2 C SOIL 2	7,69	394			
320	28. Aug 94	2 C SOIL 3	7,87	391			
321	28. Aug 94	2 C WELL	7,63	447			
322	28. Aug 94	2 C PIEZO 1	7,76	444			
323	28. Aug 94	2 X SOIL 1	7,36	1089			
324	28. Aug 94	2 X SOIL 2	7,42	1027			
325	28. Aug 94	2 X SOIL 3	7,46	775			
326	28. Aug 94	2 X SOIL 4	7,6	613			
327	28. Aug 94	2 X SOIL 5	7,64	481			
328	28. Aug 94	2 X WELL	7,41	828			
329	28. Aug 94	2 X PIEZO 1	7,25	1797			
330	28. Aug 94	2 X PIEZO 2	7,77	540			
331	28. Aug 94	2 D SOIL1	7,5	459			
332	28. Aug 94	2 D SOIL 2	7,34	581			
333	28. Aug 94	2 D SOIL 3	7,22	648			
334	28. Aug 94	2 D WELL	7,29	507			
335	28. Aug 94	2 D PIEZO 1	7,25	513			

Nr.	Date	Sample	pH	µS / cm	Isotopes	Tritium	Cations/Anions
336	28. Aug 94	2 D PIEZO 2	7,25	622			
337	29. Aug 94	3 A SOIL 1	6,56	143,2			
338	29. Aug 94	3 A SOIL 2	6,57	73,8			
339	29. Aug 94	3 A WELL	6,26	131,4			
340	29. Aug 94	3 B SOIL 1	6,27	225			
341	29. Aug 94	3 B SOIL 2	6,41	163			
342	29. Aug 94	3 B WELL	6,25	116			
343	29. Aug 94	3 C SOIL 1	6,41	137			
344	29. Aug 94	3 C SOIL 2	6,44	139			
345	29. Aug 94	3 C WELL	6,3	161			
346	29. Aug 94	3 X WELL	6,17	106			
347	29. Aug 94	3 D SOIL 1	6,54	107			
348	29. Aug 94	3 D WELL	6,15	118			
349	29. Aug 94	3 E SOIL 1	6,27	106			
350	29. Aug 94	3 E WELL	6,54	90			
351	29. Aug 94	3 F SOIL1	6,82	117			
352	29. Aug 94	3 H PIEZO 1	6,34	232			
353	29. Aug 94	3 G PIEZO 0	6,71	109			
354	29. Aug 94	3 H WELL	6,41	101			
355	29. Aug 94	3 H PIEZO 2	6,56	100			
356	29. Aug 94	3 J PIEZO 2	6,49	118			
357	29. Aug 94	3 J PIEZO1	6,34	137			
358	29. Aug 94	3 J WELL	5,87	118			

7.2: List of samples collected from typical permafrost profiles in the Labaz Lake area in 1994

Study site LA-B1 : *Terrace of the river Tolton-Pastakh-Yuryakh, close to the river valley*

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O,\delta^{2}H$	Isotope analysis ^{3}H
LA-B1 -1/ 1	0,09 - 0,14	peat with ice lenses	x				
/2	- 0,22	"	x				
/3	- 0,28	"	x				
/4	- 0,34	"	x				
/5	- 0,40	"	x				
/6	- 0,46	"	x				
/7	- 0,50	"	x				
/8	- 0,52	"	x				
/9	- 0,60	"	x				
/10	- 0,68	"	x		x		
/11	- 0,75	"	x				
/12	- 0,80	"	x				
/13	- 0,85	"	x				
/14	- 0,90	"	x				
/15	- 1,04	"	x				
/16	- 1,10	"	x				
/17	- 1,15	"	x				
/18	- 1,22	ground ice with peat material	x			x	
/19	- 1,35	"	x			x	
/20	- 1,45	"	x			x	
/21	- 1,47	"	x				
/22	1,50 - 1,54	peat with ice lenses	x				
/23	- 1,60	"	x				
/24	- 1,65	"	x				
/25	- 1,70	"	x				

Continuation: ***Study site LA-B1***

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
LA-B1 -1/26	- 1,76	peat with ice lenses	x				
/27	- 1,79	"	x				
/28	- 1,85	"	x				
/29	- 1,88	"	x				
/30	- 1,93	"	x				
/31	-1,99	"	x				
/32	- 2,10	"	x				
/33	- 2,15	"	x		x		
/34	- 2,22	"	x				
/35	- 2,30	"	x				
/36	- 2,40	"	x				
/37	- 2,48	"	x		x		
/38	- 2,54	"	x				
/39	- 2,57	"	x				
/40	- 2,62	"	x				
/41	- 2,70	"	x				
/42	- 2,78	"	x				
/43	- 2,85	"	x				
/44	- 2,90	peaty loam with ice lenses	x	x			
/45	- 2,98	"	x	x			
/46	- 3,06	"	x	x			
/47	- 3,14	peat with ice lenses	x				
/48	- 3,20	"	x				
/49	- 3,30	"	x				
/50	- 3,50	ground ice with peat material	x				
/51	- 3,55	peaty loam with large ice lenses	x	x		x	
/52	- 3,65	"	x	x			
/53	- 3,80	sand with allochthonic peaty material, with ice lenses	x	x			
/54	- 3,87	loam with allochthonic peaty material, with ice lenses	x	x			

Continuation: ***Study site LA-B1***

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
LA-B1 -1/55	- 3,97	loam with allochthonic peaty material, with ice lenses	x	x			
/56	4,00 - 4,10	"	x	x			
/57	- 4,19	peaty loam with ice lences	x	x			
/58	- 4,25	"	x	x			
/59	- 4,37	"	x	x			
/60	- 4,48	"	x	x			
/61	- 4,59	"	x	x			
LA-B1 -2/ 1	0,0 - 0,10	peaty soil	x				
/2	- 0,20	"	x	x			
/3	- 0,26	peat	x				
/4	- 0,32	"	x		x		
LA-B1 -3/ 1	1,70	peat			x		
/2	1,70	"			x		
/3	2,50	"			x		
/4	2,50	"			x		
/5	2,60	massiv ice lens in peat				x	x

Study site LA-B2 *: Terrace of the river Tolton-Pastakh Yurakh, close to a swampy lake depression with active ice wedge formation*

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
LA-B2 -1/ 1	0,32 - 0,40	peat with ice lenses	x				
/2	- 0,44	"	x				
/3	- 0,50	"	x				
/4	- 0,55	"	x				
/5	0,50 - 0,60	"	x				
/6	- 0,70	"	x			x	
/7	0,75 - 0,85	"	x			x	
/8	0.87 - 0,93	"	x			x	
/9	- 1,03	"	x			x	
/10	- 1,08	"	x			x	
/11	- 1,22	"	x			x	
/12	- 1,30	"	x			x	
/13	1,32 - 1.35	"	x				
/14	1,40 - 1,50	"	x				
/15	1,55 - 1,72	"	x				
/16	- 1,92	"	x				
/17	- 1,97	"	x				
/18	- 2,10	"	x				
/19	- 2,18	"	x				
/20	- 2,24	"	x				
/21	- 2,40	"	x				
/22	- 2,50	"	x				
/23	2,52 - 2,56	"	x				
/24	2,58 - 2,66	"	x				
/25	2,75 - 2,85	loam with allochthonic peaty material, with ice lenses	x	x		x	
/26	2,95 - 3,05	"	x	x		x	
/27	3,10 - 3,24	"	x	x		x	
/28	- 3,32	"	x	x		x	

Continuation: ***Study site LA-B2***

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
/29	3,32 - 3,40	loam with allochthonic peaty material, with ice lenses	x	x		x	
/30	- 3,50	"	x	x			
/31	- 3,55	"	x	x		x	
/32	- 3,65	"	x	x		x	
/33	- 3,75	"	x	x		x	
/34	3,78 - 3,85	sand with ice lenses		x			
LA-B2 - 2/ 1	0,00 - 0,07	peaty soil	x				
/2	0,10 - 0,20	"	x				
/3	0,36 - 0,40	"	x				

***Study site LA-B3** : Terrace of the river Tolton-Pastakh-Yuryakh, central part of ancient flood plain*

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
LA-B3 / 1	0,45-0,50	clay loam with ice lenses		x		x	
/ 2	-0,67	"		x		x	
/ 3	-0,80	"		x		x	
/ 4	-0,95	"		x		x	
/ 5	-1,05	"		x		x	
/ 6	-1,10	"		x		x	

***Study site LA-B4** : Terrace of the river Tolton-Pastakh-Yuryakh, central part of ancient flood plain*

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
LA-B4 / 1	0,25 - 0,40	clay loam with ice lenses		x		x	
/ 2	- 0,50	"		x		x	
/ 3	- 0,65	"		x		x	
/ 4	- 0,75	"		x		x	
/ 5	0,90 - 0,94	"		x		x	
/ 2	- 1,18	massiv ground ice				x	x
/ 2	- 1,40	"				x	x
/ 2	- 1,80	"				x	x
/ 2	- 2,25	"				x	x
/ 2	- 2,60	"				x	x

Study site LA-B5: *Terrace of the river Tolton-Pastakh Yuryakh, central part of ancient flood plain*

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
LA-B5 / 1	0,40 - 0,45	clay loam with ice lenses		x		x	
/ 2	0,48 - 0,60	peaty loam with ice lenses		x		x	
/ 3	- 0,70	"		x		x	
/ 4	- 0,87	"		x		x	
/ 5	- 1,10	ground ice with loam material		x		x	
/ 6	- 1,13	"		x		x	
/ 7	2,95 - 3,05	ice rich sand with allochthonic peaty material		x		x	

Study site LA-B6: *Terrace of the river Tolton-Pastakh-Yuryakh, low ancient flood bank*

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
LA-B6 / 1	0,30 - 0,50	peaty clay loam with ice lenses		x		x	
/ 2	0,60 - 0,70	"		x			
/ 3	0,95 - 1,35	layered peaty loam with large ice lenses		x		x	
/ 4	1,50 - 1,59	"		x		x	
/ 5	1,60 - 1,75	"		x		x	
/ 6	1,75 - 1,85	"		x		x	
/ 7	1,93 - 2,00	sandyl oam with large ice lenses		x		x	

Study site LA-O5: *Shore terrace of the Labaz Lake (Usun-Kaya Shore) ,*

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
LA-O5 -1 / 1	0,00 - 0,05	peaty soil	x				
/2	0,05 - 0,10	peaty loam soil	x	x			
/3	0,10 - 0,20	"	x	x			
/4	0,22 - 0,30	"	x	x			
/5	0,32 - 0,38	"	x	x			
/6	0,55	peat	x				
/7	0,80	"	x				
/8	1,40	peat with ice lenses	x		x		
/9	1,70	"	x				
/10	2,00	"	x				
/11	2,15 - 2,17	"	x				
/12	2,20	ice rich sandy loam with pebbles	x	x		x	
/13	3,20	ice rich sand	x	x		x	
LA-O5 -2/ 1	1,00	ice vein (center)				x	x
/2	1,00	ice vein (border)				x	x

Study site LA-O6: *Holocene peat bed on a Karginsk lake terrace remnant*

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
LA-O6 /1	0,00 - 0,05	peaty soil	x				
/2	0,05 - 0,10	"	x				
/3	0,20 - 0,30	peaty soil	x				
/4	0,35	peat	x				
/5	0,40 - 0,45	peaty soil	x				
/.6	0,50 - 0,60	peat	x				
/7	0,60 - 0,65	peat with ice lenses	x		x	x	
/8	0,70 - 0,80	"	x				
/9	0,85	"	x				
/10	0,90 - 1,00	silty peat with ice lenses	x	x		x	
/11	1,00 - 1,10	peat with ice lenses	x			x	
/12	1,10 - 1,15	silty peat with ice lenses	x	x	x		
/13	1,30	loam with ice lenses	x	x		x	
/14	1,40	"	x	x		x	
/15	1,50	"	x	x		x	x
/16	1,80	"	x	x		x	
/17	2,00	"	x	x		x	
/18	2,15	"	x	x			
/19	2,30	"	x	x		x	
/20	2,40	"	x	x		x	

Study site LA-O8 : *Thermokar on the northern Labaz Lake shoreline*

Sample no.	Height [m] above the thermokar bottom	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H	Micropaleon-tological analysis
LA-O8 / 1	0,0	ice rich silty clay with gravel	x	x		x		x
/ 2	1,0	and pebbles	x	x		x		x
/ 3	2,0	"	x	x		x		x
/ 4	3,2	"	x	x		x		x
/ 5	4,0	"	x	x		x		x
/ 6	5,0	"	x	x		x		x
/ 7	6,0	"	x	x		x		x
/ 8	7,0	"	x	x		x		x
/ 9	8,0	"	x	x		x		x
/10	9,0	"	x	x		x		x
/11	10,0	"	x	x				x
/12	11,0	"	x	x		x		x
/13	12,0	ice rich clay silt	x	x				x
/14	13,0	"	x	x		x		x
/15	14,0	"	x	x				x
/16	15,0	"	x	x				x
/17	16,0	"	x	x				x
/18	17,0	"	x	x				x
/19	18,0	ice rich clay silt with sand	x	x				x
/20	19,0	layers	x	x		(x)		x
/21	20,0	"	x	x		(x)		x
/22	21,0	"	x	x		x		x
/23	22,0	ice rich silty clay	x	x		x		x
/24	23,0	"	x	x		x		x
/25	24,0	"	x	x		x		x
/26	25,0	ice rich loam with pebbles,	x	x		x		x
/27	26,0	gravel,till stones, which	x	x		x		x
/28	27,0	ice wedges	x	x		x		x
/29	28,0	"	x	x		x		x
/30	29,0	"	x	x		x		x
/31	30,0	"	x	x		x		x

Study site LA-O13: *First terrace in the outflow area of Boganida River on the southern shore of Labaz Lake*

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
LA-013/ 1	0,00 - 0,05	soil covering	x				
/.2	0,10 - 0,15	peaty soil	x				
/ 3	0,20 - 0,25	buried peaty topsoil	x	x			
/ 4	0,30 - 0,40	peat	x				
/ 5	0,40 - 0,50	peat with ice lenses	x			x	
/ 6	0,50 - 0,60	ice lens in peat				x	x
/ 7	0,65 - 0,70	peat with ice lenses	x				
/ 8	0,70 - 0,80	peat with sandy loam material and ice lenses	x	x	x	x	
/ 9	0,90	"	x	x			
/10	1,10 - 1,15	peaty sand with ice cement	x	x		x	
/11	1,35	"	x	x			
/12	1,60	sand with ice cement	x	x			
/13	1,80	silty sand with ice cement	x	x			
/14	2,10	sand with ice cement	x				

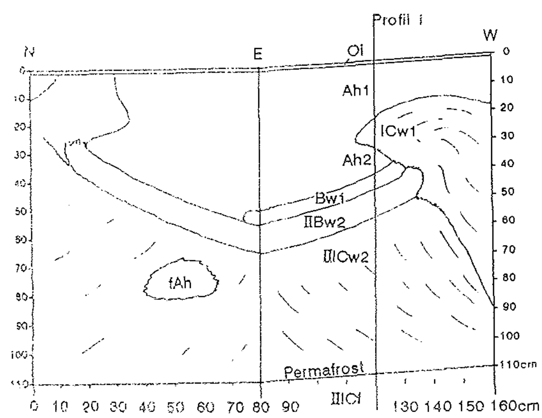
Study site LA-O14: *Flood plain in the outflow area of Boganida River on the southern shore of Labaz Lake*

Sample no.	Depth [m]	Sediment	Pollen analysis	Lithological analysis	^{14}C- dating	Isotope analysis $\delta^{18}O, \delta^{2}H$	Isotope analysis ^{3}H
LA-O14/ 1	0,00 - 0,05	soil top	x				
/ 2	0,10	peaty loam soil	x				
/ 3	0,20	silty loam	x				
/ 4	0.30	"	x				
/ 5	0,40	peat	x				
/ 6	0,50	peaty sand	x				
/ 7	0,60	sand	x	x			
/ 8	0,70 - 0,80	"	x	x			
/ 9	0,90 - 0,95	"	x	x			

7.3: Characterization of studied Soil Sites

SITE 1/PROFILE 1: Relative dry Cryosol (week cambic horizon)

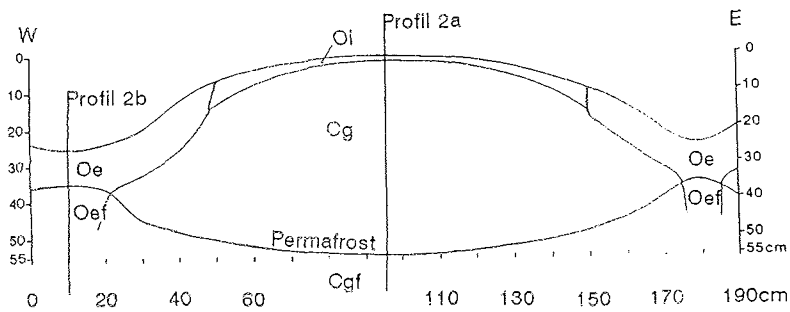
Location: Labaz Lake, Taymyr Peninsula, Middle Siberia (72°N, 100°E).
Climate (Station Chatanga): continental.
Mean annual air temperature: -13,4°C; mean july air temperature: +12,3°C.
Amount of days with temperature above 0°C: 73 days.
Mean annual precipitation: 237 mm.
Landform: moderatly hilly, lake depression, solifluction.
Altitude: 115 m.
Vegetation: dry type of subarctic, treeless tundra with lichens and small shrubs like Salix, Dryas, Ledum.
Parent material: cryoturbated holocene skeletal sediments over pleistocene medium sand.
Soil (U.S. Taxonomy): Pergelic Cryorthent.
Soil (Russian Taxonomy): Tundrovaja gleevaja merslotjana.



Depth (cm)	Horizon	Soil Description
00 - 01	Oi	weak decomposed plant material, strong rooted, brownish black (10YR3/2), week acid.
01 - 23	Ah1	brownish black (10YR2/2), humic medium sand, 60-90 vol% rock fragments, medium rooted, granular, neutral reaction.
23 - 34	ICw1	pale yellowish brown (10YR6/6), unconsolidated, weathered medium sand, 1 vol% rock fragments, week rooted, single grain, neutral reaction.
34 - 40	Ah2	brownish black (10YR2/2), humic medium sand, 70-90 vol% rock fragments, medium rooted, granular, slightly alkaline.
40 - 52	Bw1	pale redish brown (5YR5/8), weathered medium sand, 70-90 vol% rock fragments, moderatly rooted, subangular blocky, slightly alkaline.
52 - 60	IIBw2	pale redish brown (5YR5/8), weathered medium sand, 5-10 vol% rock fragments,moderatly rooted,subangular blocky, moderatly alkaline.
60 - 110	IIICw2	pale yellowish brown (10YR6/6), weathered medium sand, 1-10 vol% rock fragments, no roots, single grain, moderatly alkaline.
> 110	IIICf	medium sand, single grain, only a few rock fragments, ice crystals, ice lenses, permafrost boundary, $CaCO_3$.

SITE 2/PROFILE 2: Week gleying Cryosol

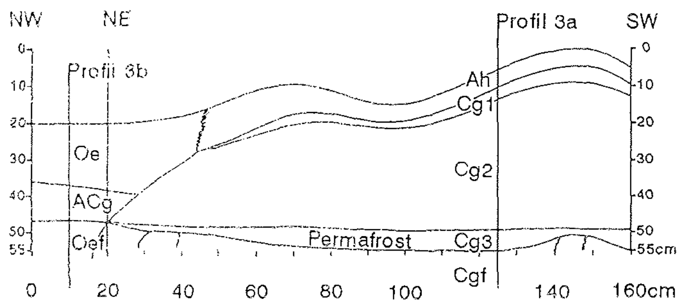
Location: Labaz Lake, Taymyr Peninsula, Middle Siberia (72°N, 100°E).
Climate (Station Chatanga): continental.
Mean annual air temperature:-13,4°C;mean july air temperature: +12,3°C
Amount of days with temperature above 0°C: 73 days.
Mean annual precipitation: 237 mm.
Landform: moderatly hilly, lake depression, solifluction.
Altitude: 65 m.
Vegetation: week wet type of subarctic, treeless, mesic spotty tundra with small shrubs like Ledum, Rubus, Betula, Vaccinium.
Parent material: loamy, cryoturbated sediments, week patterned ground, earth hummock.
Soil (U.S. Taxonomy): a.) Pergelic Cryaquept, b.) Pergelic Cryofibrist
Soil (Russian Taxonomy): a.) Gleesem, b.) Tundrovaja torfjano-merslotnaja



Depth (cm)	Horizon	Soil Description
site 2a:		
00 - 01	Oi	dark redish brown (5YR3/2), weak decomposed plant material, <1 vol% rock fragments, very strong rooted, platy, reduced iron, strongly acid.
01 - 55	Cg	pale yellowish brown (10YR4/3), weak sandy clay, 1-20 vol% rock fragments, moderatly rooted, massive, neutral.
>55	Cgf	pale yellowish brown (10YR4/3), weak sandy clay, 1 vol% rock fragments, no roots, ice lenses, permafrost boundary.
site 2b:		
00 - 10	Oe	brownish black (10YR2/2), moderate decomposed peat, <1 vol% rock fragments, moderatly acid.
>10	Oef	brownish black (10YR2/2), moderate decomposed peat, <1 vol% rock fragments, permafrost boundary.

SITE 3/PROFILE 3: Moderate gleying Cryosol (Earth Hummocks)

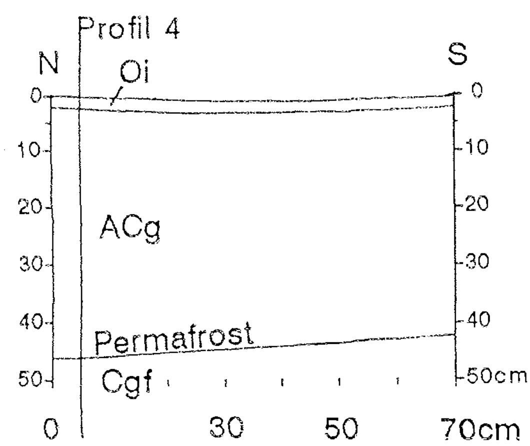
Location: Labaz Lake, Taymyr Peninsula, Middle Siberia (72°N, 100°E).
Climate (Station Chatanga): continental.
Mean annual air temperature: -13,4°C; mean july air temperature: +12,3°C.
Amount of days with temperature above 0°C: 73 days.
Mean annual precipitation: 237 mm.
Landform: moderatly hilly, lake depression, solifluction.
Altitude: 60 m.
Vegetation humid type of subarctic treeless tussock tundra with Betula, Eriophorum, Carex.
Parent material: loamy cryoturbated sediments.
Soil (U.S. Taxonomy): a.) Pergelic Cryaquept, b.)Pergelic Cryofibrist.
Soil (Russian Taxonomy): a.) Gleesem, b.) Tundrovaja torfjanisto merslotnaja.



Depth (cm)	Horizon	Soil Description
site 3a:		
00 - 05	Ah	greyish-yellowish brown (10YR4/2), humic, loamy sand, <1 vol% rock fragments, very strong rooted, massive - platy, moderatly acid.
05 - 08	Cg1	grey (5Y4/1), weak silty clay, 1 vol% rock fragments, medium rooted, platy - massive.
08 - 44	Cg2	brown (10YR4/4), weak silty clay, 1 vol% rock fragments, medium rooted, platy - massive, reduced iron, moderatly acid.
44 - 50	Cg3	olive-black - grey (5Y3,5/1), weak silty clay, 1 vol% rock fragments, medium rooted, platy - massive, reduced iron, neutral.
>50	Cgf	weak silty clay, 1 vol% rock fragments, no roots, permafrost boundary.
site 3b:		
00 - 17	Oe	brownish black (5YR2,5/1), moderate decomposed peat, <1 vol% rock fragments, neutral reaction.
17 - 27	ACg	brownish black (5YR3/1), weak silty clay, 1 vol% rock fragments, moderatly rooted, massive structure, neutral reaction.
>27	Oef	moderate decomposed, frozen peat, <1 vol% rock fragments.

SITE 4/PROFILE 4: Very strong gleying Cryosol

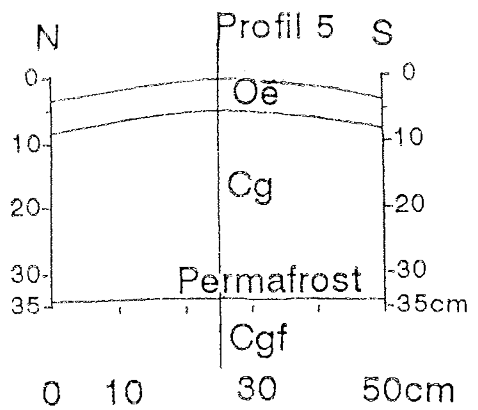
Location: Labaz Lake, Taymyr Peninsula, Middle Siberia (72°N, 100°E).
Climate (Station Chatanga): continental.
Mean annual air temperature: -13,4°C; mean july air temperature: +12,3°C.
Amount of days with temperature above 0°C: 73 days.
Mean annual precipitation: 237 mm.
Landform: moderatly hilly, lake depression, solifluction.
Altitude: 55 m.
Vegetation: very wet type of subarctic treeless tundra with Carex, Eriophorum, Sphagnen
Parent material: loamy soliflucted sediments, low solifluction.
Soil (U.S. Taxonomy): Pergelic Cryaquept .
Soil (Russian Taxonomy): Tundrovaja bolotnaja gleevaja merslotnaja



Depth (cm)	Horizon	Soil Description
00 - 02	Oi	very dark brown (10YR2/1-2), slightly decomposed plant material, loose, very strong rooted, week acid, massive.
02 - 42	ACg	dark yellowish brown (10YR4/6) + very dark grey (5Y3/1), sandy clay loam, medium rooted, neutral reaction, massive - platy, reduced iron.
>42	Cgf	very dark grey (5Y3/1), sandy clay loam, permafrost boundary.

SITE 5/PROFILE 5: Strong gleying Cryosol

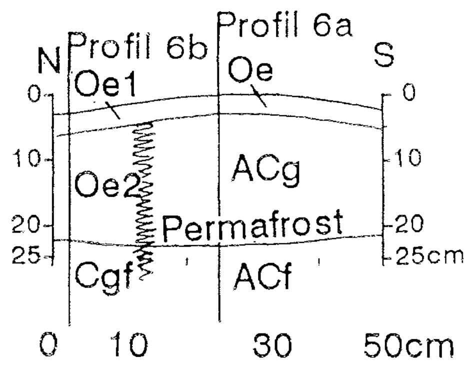
Location: Labaz Lake, Taymyr Peninsula, Middle Siberia (72°N, 100°E).
Climate (Station Chatanga): continental.
Mean annual air temperature: -13,4°C; mean july air temperature: +12,3°C.
Amount of days with temperature above 0°C: 73 days.
Mean annual precipitation: 237 mm.
Landform: moderatly hilly, lake depression, solifluction.
Altitude: 65 m.
Vegetation: wet type of subarctic treeless tundra with small shrubs like Vaccinium, Cassiope, Betula.
Parent material: loamy cryoturbated sediments, week solifluction.
Soil (U.S. Taxonomy): Pergelic Cryaquept .
Soil (Russian Taxonomy): Gleesem.



Depth (cm)	Horizon	Soil Description
00 - 05	Oe	brownish grey (5YR5/1), moderate decomposed organic material, 0-10 vol% rock fragments, strong rooted, granular - massive, reduced iron.
05 - 34	Cg	grey (5Y41/), sandy clay-loam, <1 vol% rock fragments, medium rooted, massive - platy, reduced iron.
>34	Cgf	sandy clay-loam, no rock fragments, permafrost boundary.

SITE 6/PROFILE 6: Moderate gleying Cryosol (Icewedge Polygones)

Location: Labaz Lake, Taymyr Peninsula, Middle Siberia (72°N, 100°E).
Climate (Station Chatanga): continental.
Mean annual air temperature: -13,4°C; mean july air temperature: +12,3°C.
Amount of days with temperature above 0°C: 73 days.
Mean annual precipitation: 237 mm.
Landform: moderatly hilly, lake depression, solifluction.
Altitude: 60 m.
Vegetation: moderate wet type of subarctic treeless tundra with Eriophorum and small shrubs like Vaccinium, Rubus, Betula.
Parent material: silty sediments over pleistocene sands.
Soil (U.S. Taxonomy): a.) Pergelic Cryaquept, b.) Pergelic Cryofibrist
Soil (Russian Taxonomy): a.) Tundrovaja bolotnaja gleevaja merslotnaja, b.)Tundrovaja torfjanisto-merslotnaja



Depth (cm)	Horizon	Soil Description
site 6a:		
00 - 03	Oe	brownish black (5YR2,5/1), moderate decomposed organic material, <1 vol% rock fragments, very strong rooted.
03 - 23	Acg	dark redish brown (5YR3/4), silt, <1 vol% rock fragments, straong rooted, massive.
>23	ACf	weak silty middle sand, <1 vol% rock fragments, no roots. massive, permafrost boundary.
site 6b:		
00 - 03	Oe1	brownish black (5YR2,5/2), moderate decomposed peat, very strong rooted, <1 vol% rock fragments, massive.
03 - 19	Oe2	dark redish brown (5YR3/4), moderate decomposed peat, <1 vol% rock fragments, medium rooted.
>19	Cgf	weak silty middle sand, <1 vol% rock fragments, permafrost boundary, massive.

7.4 List of the Participating Institutions

Contry and Institution		No of Participants
Germany		
AWI	Alfred Wegener Institute for Polar and Marine Research Research Unit Potsdam Telegrafenberg A43 D-14473 Potsdam	4
IPÖ	Institute for Polar Ecology University of Kiel Wischhofstr. 1-3, Geb. 12 D-24148 Kiel	1
IfB	Institute of Soil Sciences Universtity of Hamburg Allende Platz 2 D-20146 Hamburg	1
Russia		
AARI	Arctic and Antarctic Research Institute Department of Polar Geography Bering St. 38 St. Petersburg 198 255 , Russia	5
MSU	Moscow State University Department of Geocryology Moscow 119899, Russia	2
BIN	Komarov Botanical Institute Russian Academy of Sciences Prof. Popov Str. 2 St. Petersburg 197 376, Russia	1