Russian-German Cooperation: The Transdrift I Expedition to the Laptev Sea

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Russian-German Cooperation: The Transdrift I Expedition to the Laptev Sea

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Kassens, H. and Karpiy, V.

In the fall of 1993 Russian and German scientists returned from the two-month-long TRANSDRIFT I expedition heavily laden with new scientific results and numerous personal impressions. The Laptev Sea - the largest ice factory in the Arctic Ocean - was the destination of the expedition carried out aboard the Russian RV *Ivan Kireyev* (Fig. 1). In this shelf region, which is ice-free for only three months each year, a comprehensive meteorological, oceanographical, chemical, biological and geological working program was conducted in bilateral cooperation.

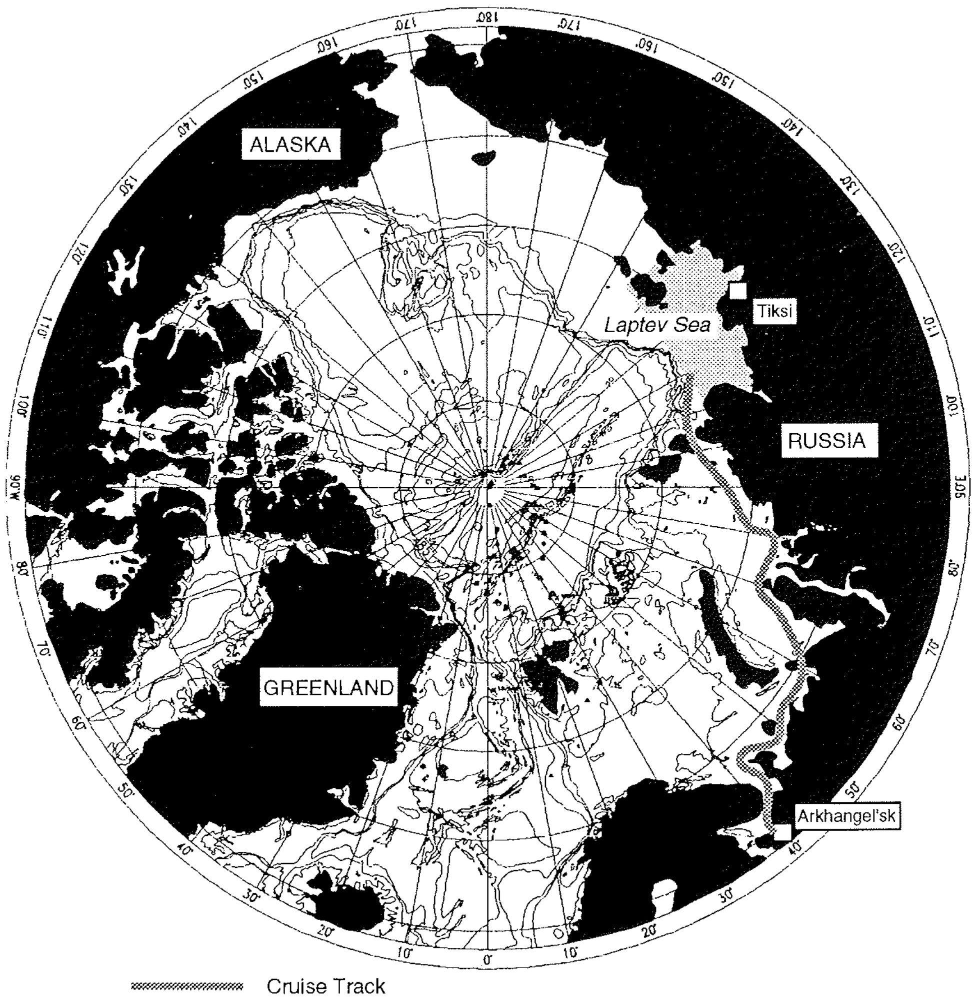


Fig. 1: The cruise track of RV *Ivan Kireyev* along the Northern Sea Route to the Laptev Sea during the TRANSDRIFT I expediton.

The TRANSDRIFT I expedition was part of the joint Russian-German ARCTIC '93 Expedition. At the same time the German RV *Polarstern* of the Alfred Wegener Institute for Polar and Marine Research was working in the pack ice of the northern Laptev Sea as well as in the eastern Nansen Basin (Fütterer et al., in press.). The interdisciplinary research programs of the *Polarstern* and the *Ivan Kireyev* were closely coordinated. The cornerstone for the bilateral cooperation in the Laptev Sea was laid during the workshop "Russian-German Cooperation in and around the Laptev Sea" in St. Petersburg from May 10 to 13, 1994 (Kassens et al., in press).

The Arctic and Antarctic Research Institute in St. Petersburg and the GEOMAR Research Center for the Marine Geosciences in Kiel were jointly responsible for the organisation and coordination of the TRANSDRIFT I expedition, which was funded by the Russian Ministry for Research and Technology and the German Ministry for Research and Technology. Thirteen Russian scientists from the Arctic and Antarctic Research Institute (St. Petersburg), the All-Russian Research Institute (St. Petersburg), the Zoological Institute (St. Petersburg), the Institute of Experimental Meteorology (Obninsk), and thirteen German scientists from the Alfred Wegener Institute for Polar and Marine Research (Bremerhaven and Potsdam), the Institute for Polar Ecology (Kiel), the Institute for Marine Sciences (Kiel), the Institute for Geology (Freiberg), and the GEOMAR Research Center for Marine Geosciences (Kiel) participated in the TRANSDRIFT I expedition (Tab. A1).

RV *Ivan Kireyev* (length over all 70 m) is a Russian research vessel belonging to the Hydrographic Department of Arkhangelsk (Fig. 2). It was built in Finland 20 years ago and is especially equipped for work in oceanography and acoustics at high latitudes (class 3 ice capability). Hence only one crane with a load capacity of 5 tons was available. However, we were able to dredge and to take sediment cores up to 5.5 meters in length. To summarize our experiences on board, RV *Ivan Kireyev* was well suited for the planned research program. Due to the ship's good sailing properties and even inspite of the stormy weeks which existed during September, the success of our expedition is to no small extent the result of an experienced crew under the command of Captain Kataev.

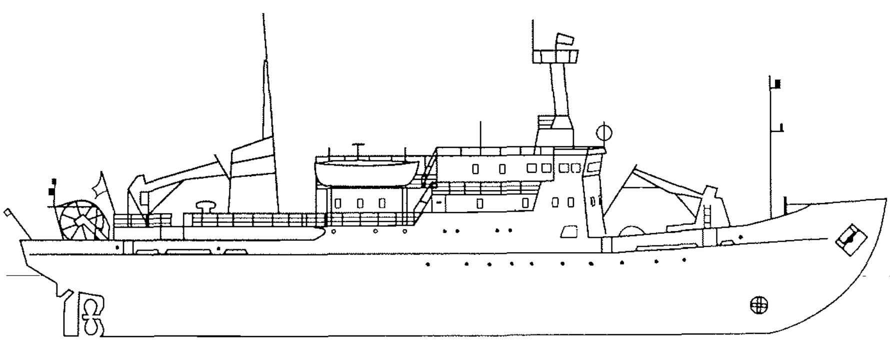


Fig. 2: Diagram of RV *Ivan Kireyev*.

The scientific goal of the TRANSDRIFT I expeditionis the investigation of the Arctic environment and its significance for global climate. The remarkably shallow shelf region of the Laptev Sea (Fig. 3), which is characterized by high

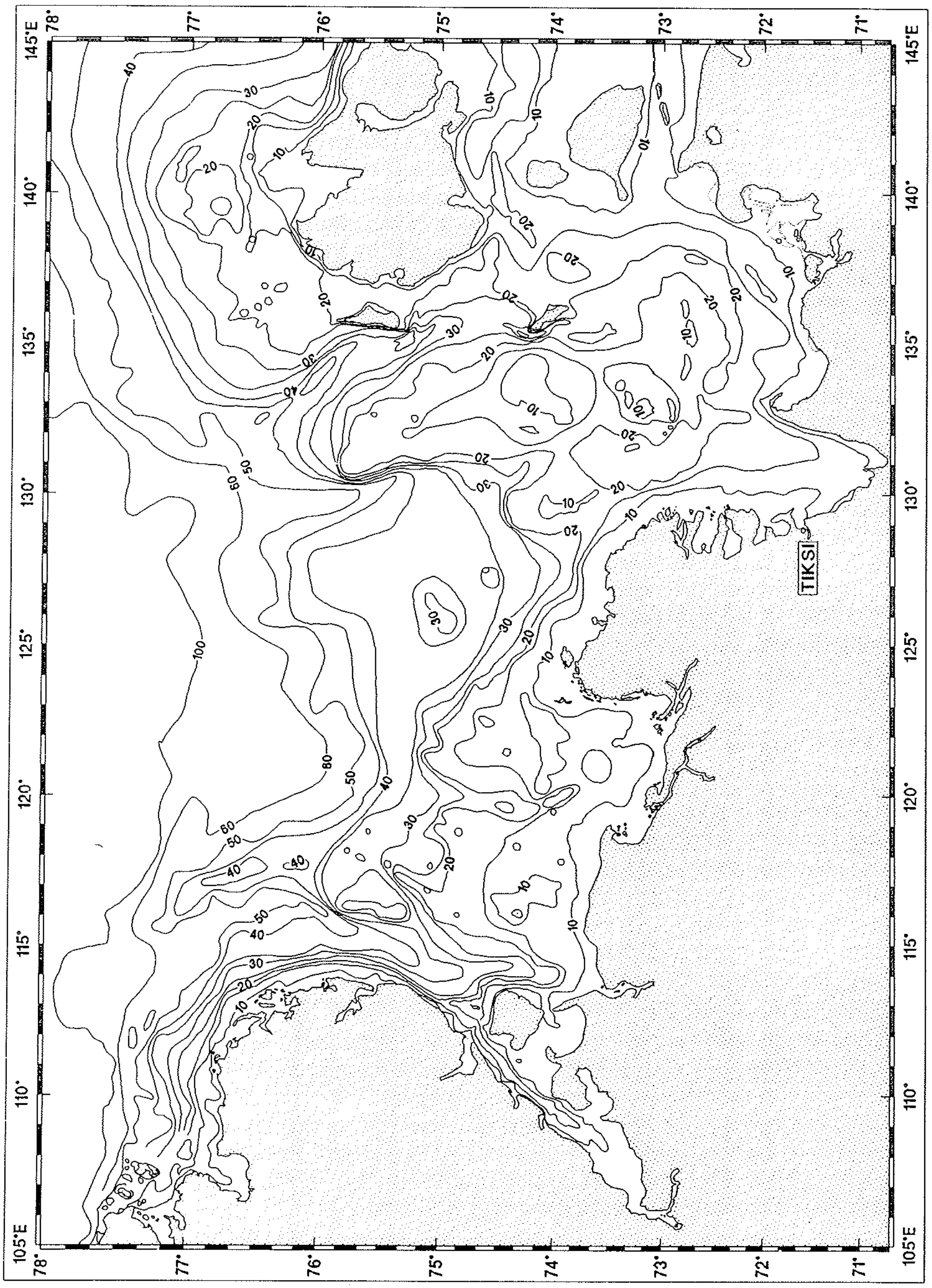


Fig. 3: The bathymetry of the Laptev Sea.

amounts of run-off from the large Siberian river systems, such as the River Lena, the eigth largest river on earth, is a key region for gaining an understanding of the workings of global change. During the winter months the majority of Arctic sea ice for the Transpolar Drift is produced here. Thus explaining why the Laptev Sea is also called the 'ice factory' of the Arctic Ocean. The ice produced here drifts with the Transpolar Drift over the Arctic Ocean and through the Fram Strait into the Norwegian-Greenland Sea. Arctic sea ice generally drifts two to three years before it reaches its destination and melts.

The relatively thin ice cover of the Arctic Ocean (average 3 to 4 meters) influences the gas and heat exchange between ocean and atmosphere and, thus, the global heat budget and ocean circulation as well. Global changes, such as a rise in the average temperature of the atmosphere, are expected to trigger drastic changes in the Arctic system in the near future. Thus, it is evident that the Arctic functions as an early warning system for the greenhouse effect.

Investigations of the atmosphere, the water column and the sea floor were carried out by the working group on board the RV *Ivan Kireyev* in order to gain a broad view of the environment of the Laptev Sea. A working program was conducted on a total of 98 stations in the shelf area, including those located at river mouths (Fig. 4). The biological, chemical and geological works focussed on 47 stations. This has led to the compilation of a high-resolution sample and data network, which will be investigated by teams of Russian and German scientists during the upcoming months. The focus of these investigations is placed upon the impact of river run-off, on ice formation, on the habitats of plankton and benthos, and on sedimentation. In addition, chemical analyses will provide an estimation of pollution introduced into the Arctic Ocean by the Siberian rivers.

1.1 The Course of the TRANSDRIFT I Expedition

The RV *Ivan Kireyev* departed from the port of Arkhangelsk (Fig. 1) on August 2, 1993, and crossed the ice edge of the Kara Sea three days later, where the Russian icebreaker *Taymyr* was already waiting to assist. In a convoy both ships then sailed for two days through the Strait of Vilkitzky. Reaching the Taymyr Ice Massif the *Taymyr* was relieved by the icebreaker *Rossia*, which escorted the RV *Ivan Kireyev* as far as the ice-free southern Laptev Sea. Due to excellent weather conditions and perfect Russian logistics, we reached our working area in the record time of only seven days.

Thus, much earlier than anticipated, we began our research activities with the hydrographic Station IK9360 at 23:15h on August 8, 1993, in the vicinity of the ice edge in the western Laptev Sea (Fig. 5). After comprehensive testing of the oceanographic equipment, we went directly to Station IK9361, where we successfully carried out the entire interdisciplinary working program for the first time. After that we decided to continue the work in the southwestern Laptev Sea because of favorable ice conditions there.

Following seventeen days of work in the southern Laptev Sea, we planned our first port call in Tiksi on August 24 in order to load fuel and water and to visit the Hydrographic Department and the Lena Delta Reserve in Tiksi. Unfortunately, due to stormy conditions, there was no room for us at the pier in

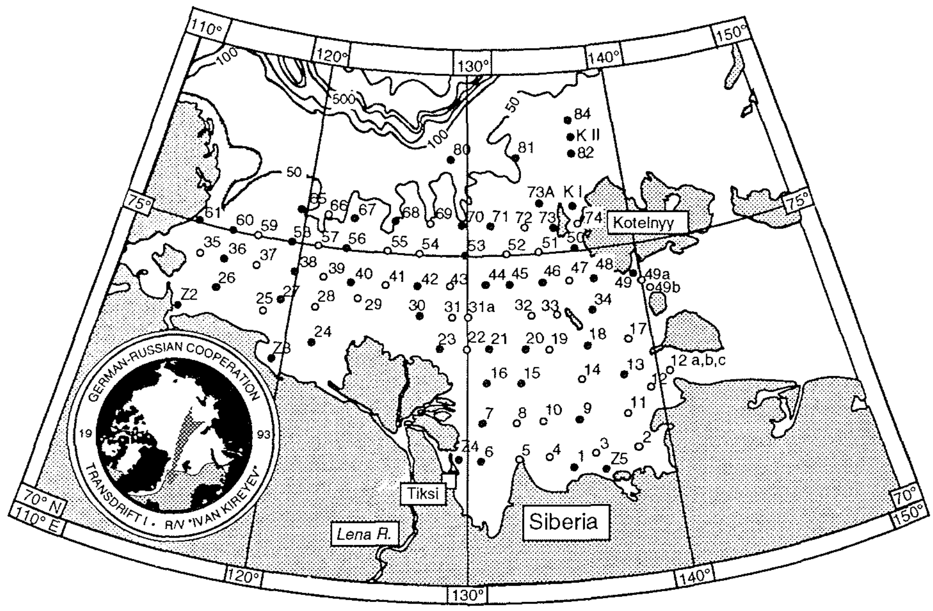


Fig. 4: Map showing the Laptev Sea and sample locations. The samples were collected during the TRANSDRIFT I expedition. Oceanographical sample locations are marked by open circles. Oceanographical, biologicalcal and geological samples locations are marked by closed circles.

Tiksi, thus forcing us to anchor outside the harbor. We did not receive permission to enter the harbor of Tiksi until 4:00h on August 26. Our stay in Tiksi was characterized by intensive scientific exchange with our colleagues from the Lena Delta Reserve and the Hydrographic Department in Tiksi. At the close of our visit, our determination to continue this close cooperation was documented by signing a joint letter of intent for future cooperation.

Furthermore, we established first radio contact with RV *Polarstern* on August 26. At that time RV *Polarstern* was located at 77°50'N and 102°34'E, that is, in the western Vilkitzkiy Strait, where she was waiting for a Russian ice breaker. We agreed to establish radio contact daily at 18:30h GMT to exchange new scientific results and to coordinate the cruise route.

In general, the first leg of the cruise was successful. Thanks to good to very good weather and ice conditions (Fig. 6), we had been able to carry out our working program at 49 stations. Thus making it possible for us to complete a large portion of the total working program during the first leg. Due to heavy ice conditions, we had only not been able to reach the planned stations in the Khathangar mouth area and in the region of the Taymyr Ice Massif.

On the afternoon of August 27, we left Tiksi to continue the working program east of Tiksi at Station IK9306. Here in the ice-free southern Laptev Sea we continued our working program until August 30. During this time ice conditions in the northern Laptev Sea began to improve, and RV *Ivan Kireyev* left the southeastern Laptev Sea on August 31 to head north.

On September 1 we briefly rendezvoused RV *Polarstern* at 76°30'N and 133°20'E at Station IK9381 in order to calibrate oceanographic tools, such as

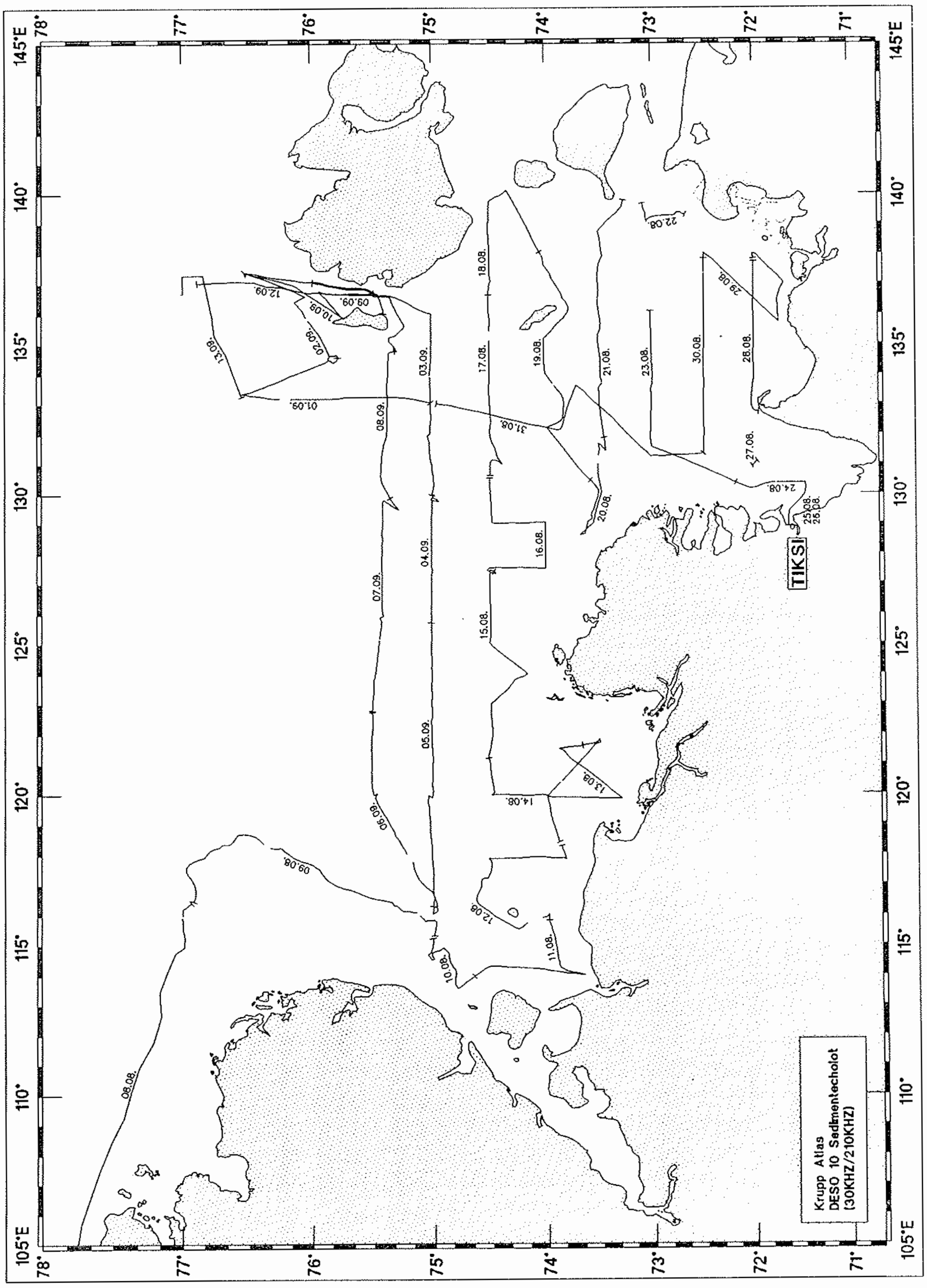


Fig. 5: Cruise track in the Laptev Sea of the TRANSDRIFT I expedition

Air Temperature and Wind Speed in the Laptev Sea
(Transdrift I Expedition)

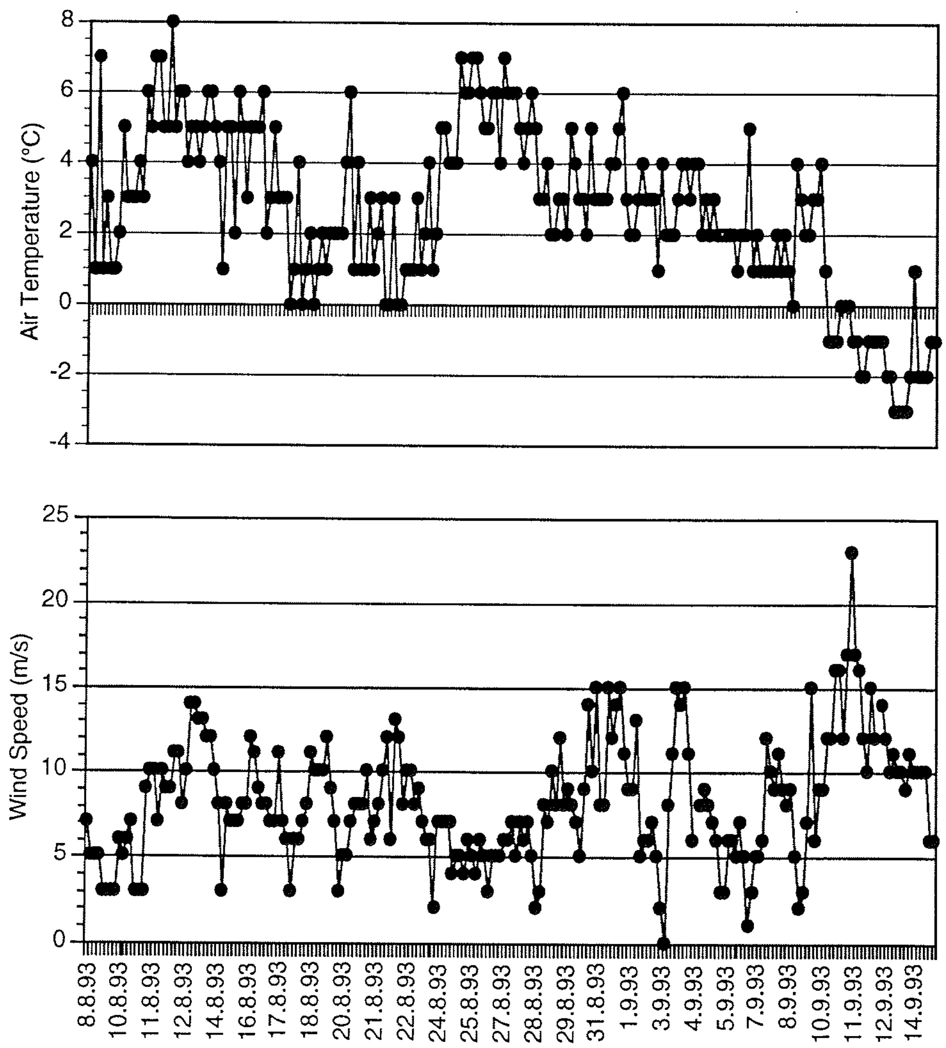


Fig. 6: Air temperature and wind speed in the area of the Laptev Sea during the TRANSDRIFT I expedition.

CTD, exchange samples, store some food and borrow 400 kg of pene-tration weight for our gravity corer. Weather became stormy, putting an end to our meeting after three hours.

After the meeting with RV *Polarstern* , we continued our work southwest of Kotel'nyy Island, where we deployed two of our three moorings at Station IK93K1 and IK93K2. During these days the weather became stormy and cold, severely restricting our station work (Fig. 6). On September 11 and 12, we were forced to discontinue all station work and seek shelter between Kotel'nyy and Bel'kowsk'y Islands. On September 13 we deployed our last mooring at Station IK9382A and finished our geological working program at Station IK9384. After that we sailed further north to the ice edge in order to carry out high resolution measurements with one mile intervals along two ten-mile-long transects.

On the evening of September 14, we completed our working program in the Laptev Sea and left our working area to return to Tiksi. From there, the German scientists returned by plane to Germany via Moscow on September 19. One day later RV *Ivan Kireyev* journeyed with ice breaker support through the Strait of Vilkitzky. West of Taymyr Peninsula RV *Ivan Kireyev* met with RV *Polarstern* once again on September 23 in order to exchange Russian and German cargo. After a final stop in the Bay of Yenisey to store fresh water RV *Ivan Kireyev* returned to Arkhangelsk. On her way, six additional oceanographic stations in the Kara Sea were occupied. Following completion of two months of successful work in the Laptev Sea, RV *Ivan Kireyev* arrived in Arkhangelsk on October 5 (Fig. 1).

1.2 Navigation

Benthien, A., Benthien, R. and Kataev, A.

For navigation a GPS-navigator (RS 5300C & keypad RS 5310, Shipmate, 9530 Støvring, Denmark) was used in combination with a special navigation program called PC Log (written from Dr. J. Rathlev, Institut für Angewandte Physik, Kiel, Germany) on our personal computer. This program is able to store the actual position in variable time cycles and shows the ship track on the screen (Fig. 7). During the cruise a storage cycle of 600 sec. was used, for special applications like Side Scan profiling or dredging it was changed to a 60 sec. cycle.

The GPS-system was installed on the bridge next to other navigational instruments belonging to the ship, e. g. sonar, log, radar, and a second satellite navigator (Magnavox Dual-Channel Satellite Navigator MX 1107 RS, USA).

All station positions were located with GPS, also the drift of the ship. The dinghy and iceberg positions were determined with radar in combination with GPS. The height of icebergs was estimated by using a sextant.

1.3 Ice Conditions in the Laptev Sea

Churun, V.

The cruise of the R/V *Ivan Kireyev* during the joint Russian-German expedition in 1993 was mainly carried out in ice-free water. Oceanographic, geological and biological works were executed in the ice-free area of the Laptev Sea. In some cases the observations were carried out between scattered ice floes or drifting ice cakes of first-year ice.

Ice conditions in the Laptev Sea during 1993 were characterized by a very pronounced ice opposition between the western and eastern parts.

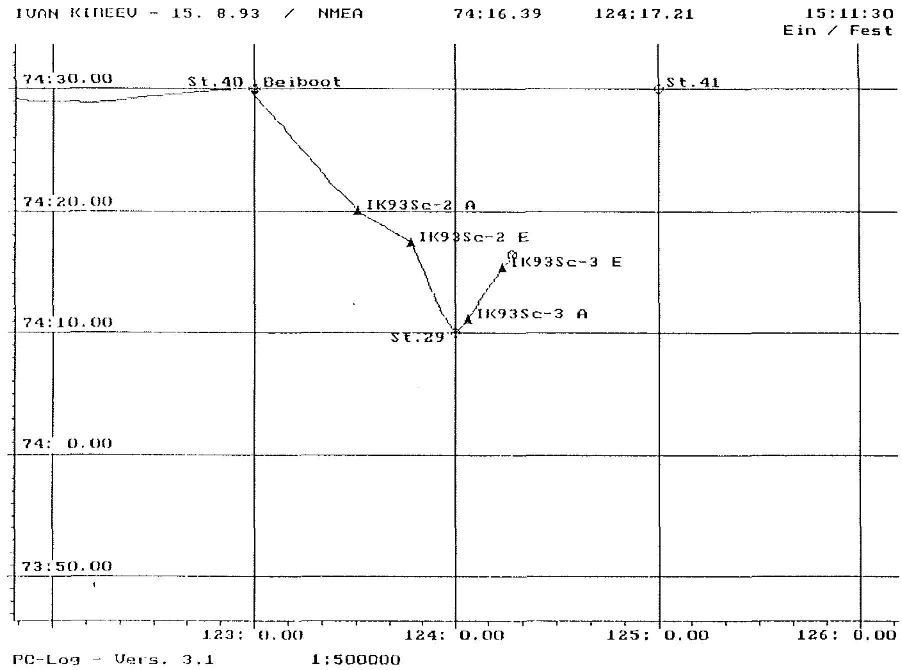


Fig 7: A screen print from 15. August 1993 at 15:11 (GMT). Two Side Scan profiles (IK93Sc-2 & IK93Sc-3) are shown.

With the support of the icebreakers *Taimyr* and *Rossiya*, the *Ivan Kireyev* arrived in the Laptev Sea in the first decade of August. The fast ice in the Vil'kitskiy Strait had broken up at that point of time. So the area turned out to be ice-free.

During the expedition works a persistent, wedge-like projection of close ice was observed in the western part of the sea, which belonged to the Taimyr ice massif and was about 60 to 80 miles wide. It mainly consisted of old and thick first year ice with a ridge extent up to 3/10. Sometimes the southern tip of this ice projection was pressed against the Bol'shoy Begichev Island. Between the projection and the eastern coast of the Taimyr peninsula, there were local zones of open and very open floating ice, which closed periodically. Thus the conditions of this part of the sea required the support of icebreakers during the entire passage (Fig. 8). Moreover, the presence of close ice in the western part of the sea did not allow us to observe a number of planned stations.

In the eastern part of the sea, ice conditions were favourable during the whole expedition works. A local patch of the Yanskiy ice massif with a radius of 35 miles remained between the 134 and 139 E meridians until the end of August. It mainly consisted of medium ice floes of different forms with a concentration up to 7-8/10 in some places. The presence of this patch did not allow the works at the oceanographic station 13. By the first decade of September it had completely melted away. In the New-Siberian Straits, ice had completely disappeared by the end of August and separate ice floes, patches and belts of drifting ice with a concentration up to 4-6/10 were observed. The southern part of the sea from the Khatanga Bay to the Buorkhaya

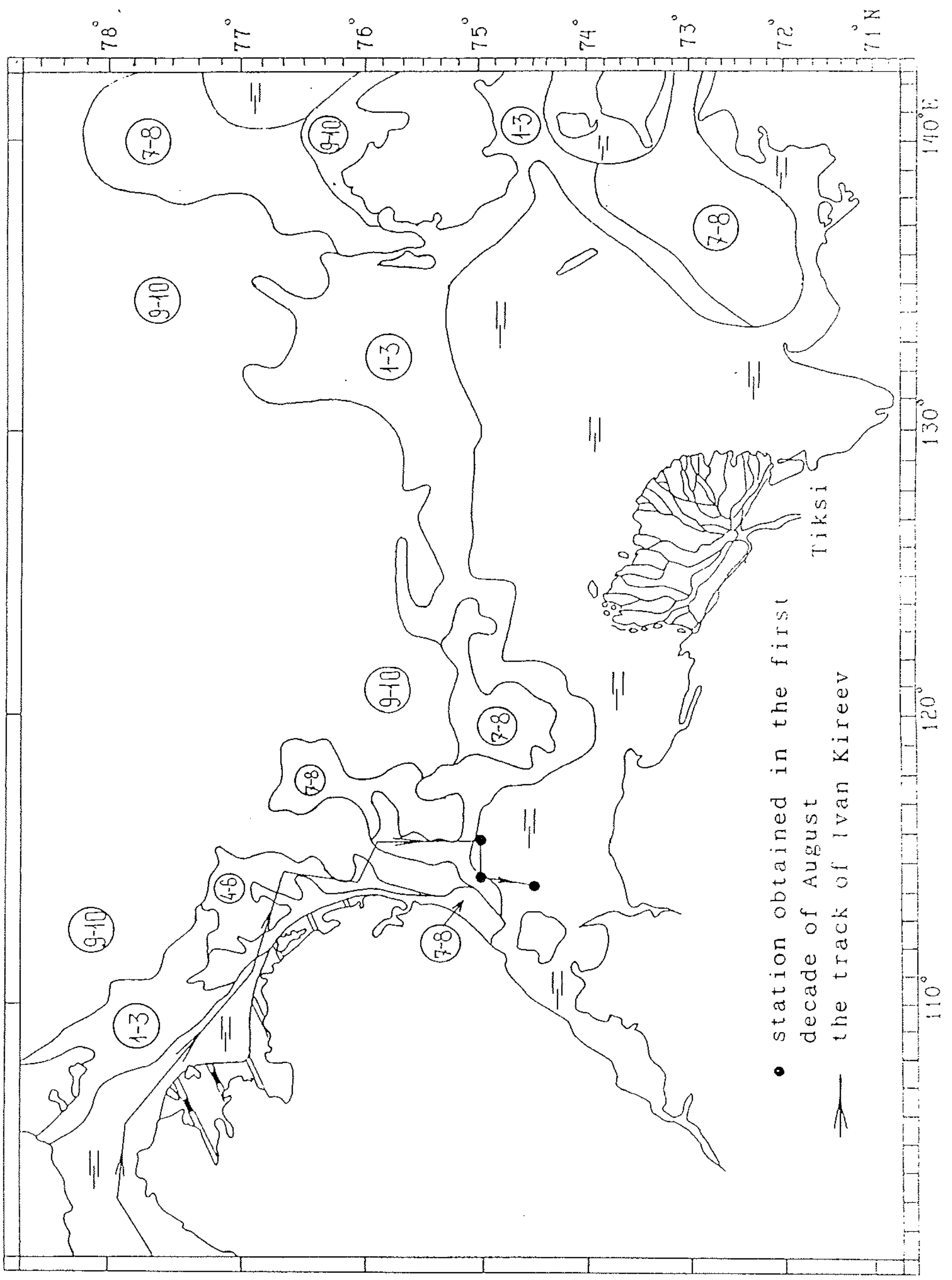


Fig. 8: Ice conditions in the Laptev Sea during the first decade of August 1993

Cape was absolutely ice-free as early as in the first decade of August. In the second and third decade of August the eastern part of the Vil'kitskiy Strait was filled with drifting ice under the effect of eastern, north-eastern winds (Fig. 9).

In the first decade of September, the drifting ice edge shifted in northern and north-western direction, approximately by 20 to 40 miles. This process became particularly apparent northward of the Kotel'nyy Island, where the edge reached 79° N. Then under the effect of eastern and north-eastern winds, the ice edge shifted a little back to the south, south-east. Ice conditions, however, did not change significantly so that the expedition works were not effected by this shift (Fig. 10).

With the support of the nuclear icebreaker *Arktika*, the *Ivan Kireyev* left the Laptev Sea along the chain of leads and fractures between the ice of the Taimyr massif and the coast of the Taimyr peninsula.

On the whole ice conditions were favourable for the expedition works in the southern and eastern parts and difficult in the western and north-western parts of the Laptev Sea.

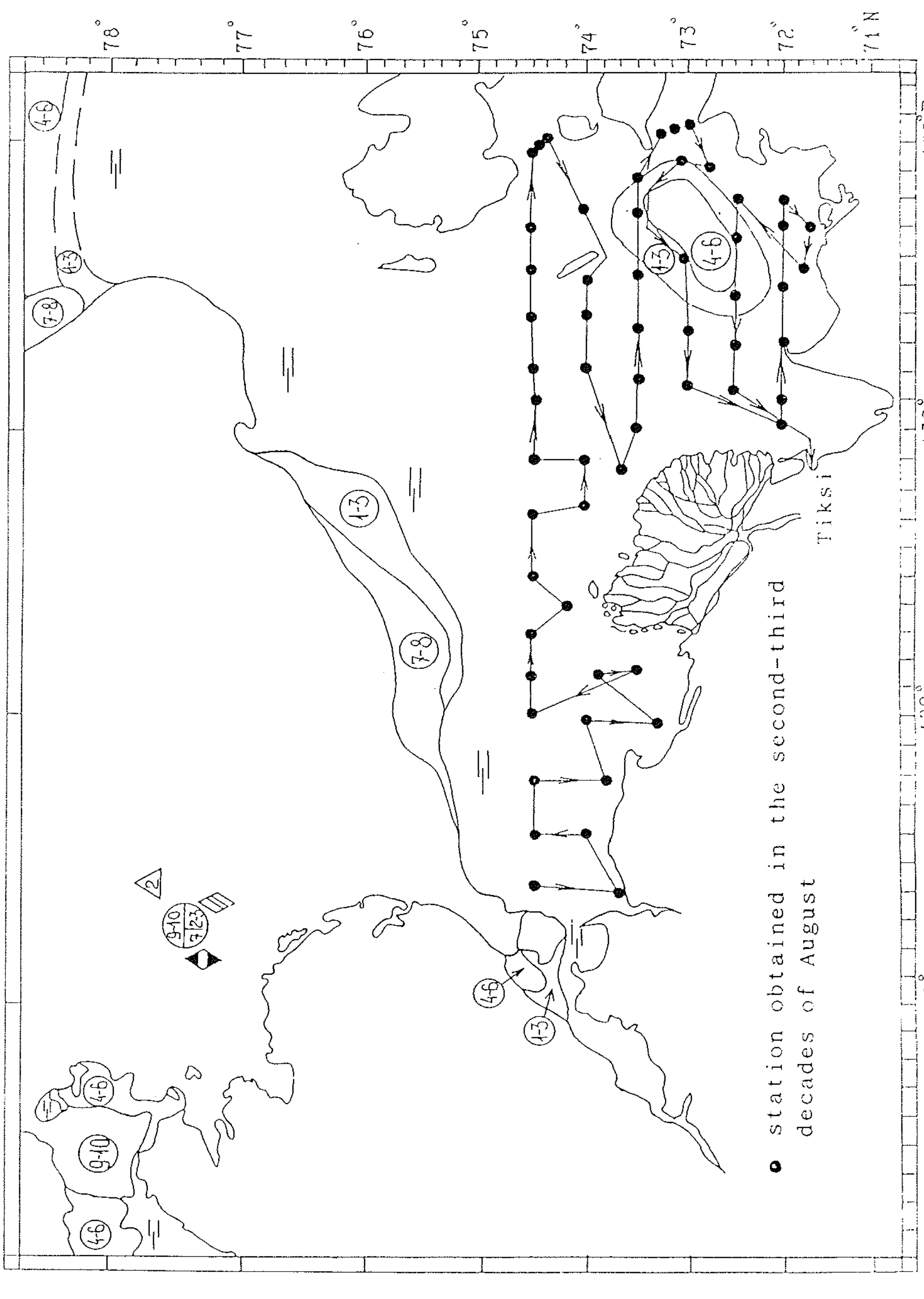


Fig. 9: Ice conditions in the Laptev Sea during the third decade of August 1993

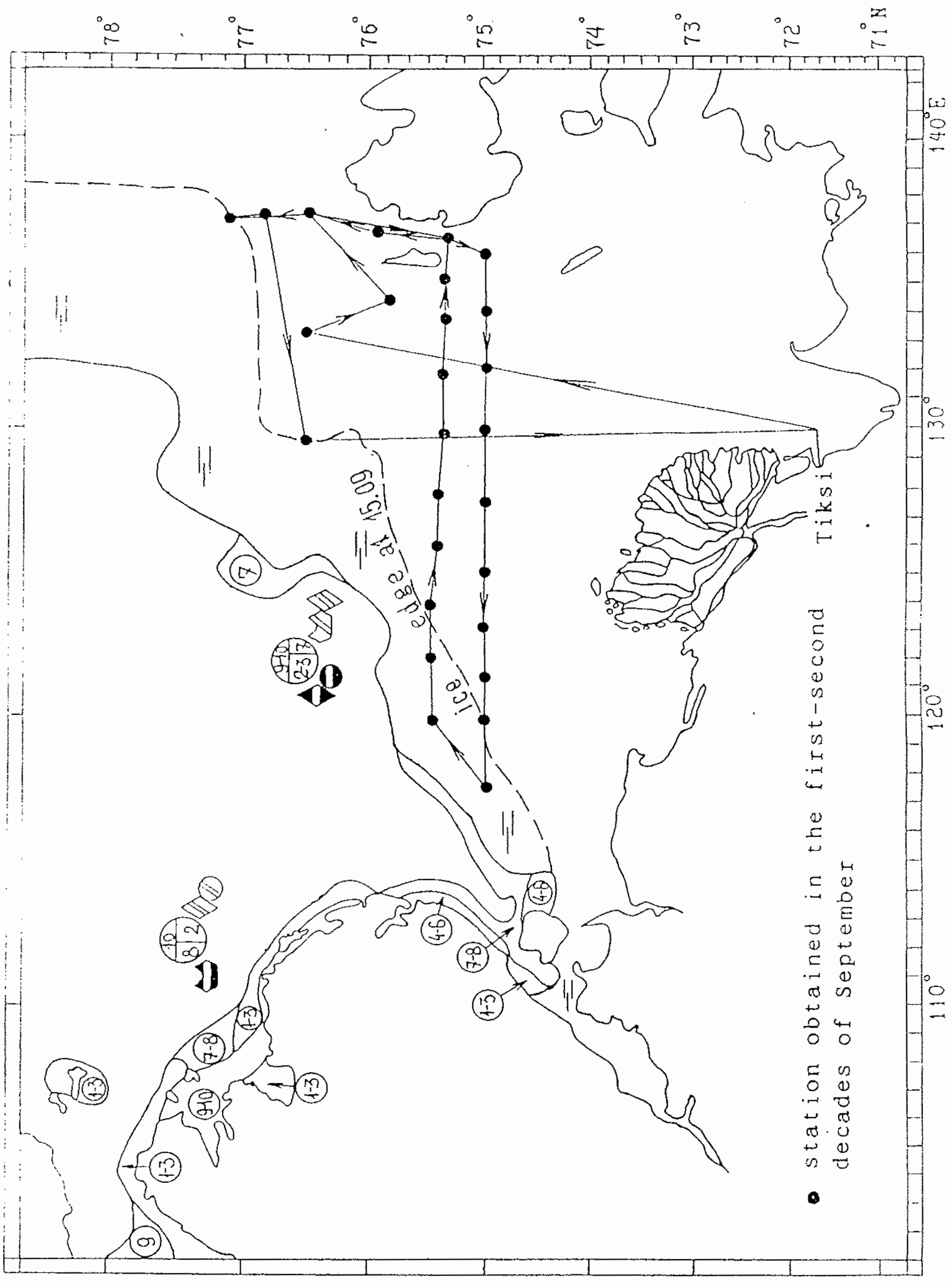


Fig. 10: Ice conditions in the Laptev Sea during the first decade of September 1993

2. METEOROLOGICAL STUDIES

2.1 Processes of Air-Sea Interaction in the Laptev Sea

Fentshenko J., Blumm E. and Masalkin V.

It is known that the ice cover formation in the Laptev Sea is rather non-uniform. The reasons for this non-uniformity are still inadequately studied. In the warmer season of the year, the process of sea ice formation depends on meteorological conditions (in particular on the thermal balance of the sea surface). Since before the TRANSDRIFT I expedition no experiments had been made in order to investigate the heat exchange processes between the ocean and the atmosphere in the Laptev Sea in the summertime, a set of corresponding observations had to be included into the research program of the expedition. These investigations were carried out by scientists of the Department of Sea-Air Interaction and the Department of Meteorology of the AARI.

The meteorological group had two main tasks. The first one was to find out the meteorological parameters that determine the processes of air-sea interaction in the Arctic Ocean. The second one was to provide hydrometeorological support for the expedition and the coastal meteorological services.

Observation Scope

The program of meteorological investigations included a set of standard meteorological observations, continuous measurements of incoming long-wave and short-wave radiation, and the measurement of sea surface temperature and of total atmospheric ozone.

Standard meteorological observations were made at 00, 03, 06, 09, 12, 15, 18, 21 GMT. The observations were carried out according to the "Manual for Hydrometeorological Stations and Posts", issue 9, part 2, and according to the "Methodical Instructions of the AARI".

The air temperature and humidity observations were made with the aspiration psychrometer. The direction of wind was measured by means of the ship weather station SDS-6. The speed of wind was measured with a manual anemometer, water temperature with a resistance thermometer (recording with KSP-4 self-recorder), air pressure with aneroid. Swell. Cloudiness and visibility range were determined visually. Total solar radiation was measured with the pyranometer M-115-M, incoming long-wave radiation with the infrared radiometer of the Main Geophysical Observatory (GGO) (continuous recording with the KSP-4 self-recorder). Total atmospheric ozone was measured with the M-124 ozonometer.

Preliminary Results

Three hundred and sixty-five sets of meteorological observations were carried out during the observation period. These data were sent to Moscow Pogoda, Tiksi Gimet.

During the cruise the meteorological group calculated the turbulent fluxes of sensitive and latent heat for August and September. Mean values of the fluxes were 7.2 W/m^2 and 28.7 W/m^2, and 37.1 W/m^2 and 49.5 W/m^2, respectively. The value of mean daily total solar radiation was 107 W/m^2 in August and 51.7 W/m^2 in September. Long-wave radiation balance was 29.5 W/m^2 and 38.3 W/m^2 in August and September, respectively.

The mean monthly value of total ozone content was 0.284 cm (71 observations were executed) in August and 0.285 cm (53 observations were made) in September. The obtained results of the total atmospheric ozone measurements correspond with the mean values of many years, that are typical of this region and this time of the year.

Owing to specific features of meteorological observations aboard a ship, the collected preliminary data have to be corrected. In particular, the value of counterradiation of the atmosphere was lowered a little since the radiometer was mounted at a height of 10 m over the water surface and did not take into account the radiation of the atmospheric layer lower than 10 m. The value of this layer, however, is probably significant (especially during fog). It is noted that the constituents of heat balance considerably vary according to the season and region. Altogether this reflects the special features of this area. The observations together with hydrological data and the data on the ice edge position shed some light on the value of the constituents of heat balance in the southern Laptev Sea and on its variability in the summertime.

Scientific Prospects

It is planned to describe the ice cover formation process in the southern part of the sea by means of the quasistationary-zero-dimensional sea ice model, which was developed at the AARI. In order to investigate the air-sea interaction processes in this region more detailed, some local features should be taken into account. A significant river run-off at a comparatively small depth of the sea itself appears to be one of the features of the southern Laptev Sea. Warmer river waters significantly change the structure of surface heat balance. Furthermore, it is planned to draw up a more detailed description of the spatial distribution of the heat balance components with the aim of finding out their relationship to the features of the sea surface layer. Temporal variability of the heat balance constituents also appears to be of interest. The diversity of the factors affecting it (ice edge position, direction of wind, etc.) requires further studies in this region. It is also planned to carry out direct observations of long-wave surface radiation in the future. All this will allow us to describe the processes of air-sea interaction more detailed and more correctly.

3. OCEANOGRAPHIC STUDIES

3.1 Thermohaline and Dynamic Water Structure in the Laptev Sea

Karpiy V., Lebedev N. and Ipatov A.

The oceanographic regime of the Laptev Sea is characterized by the main features that are typical of other marginal Arctic seas. These features are: severe climate, ice cover presence, intensive desalination in summer due to river run-off and ice melt, presence of extensive transformation zones of water masses of different origin considerably differing in their characteristics. In this respect the studies of the Laptev Sea serve as a basis for understanding the features of the estuaries and the seas of the arctic region, i.e. the Laptev Sea can be considered not only as a research but as a methodical polygon as well. The constructed models as well as the obtained features of the Laptev Sea can be extended to other Arctic seas, too.

The oceanographic regime of the Laptev Sea has, however, its own characteristic features, which are different from the regime of other seas of the Arctic region. Such features are: different water structures in the eastern and western sea part (Arctic Surface Waters and Atlantic Deep Waters prevail in the western part, while the waters of the continental discharge play a major role in the formation of the hydrological regime in the eastern part), presence of an extensive water area occupying the largest portion of the sea, presence of a quasi-stationary polynya in the north-eastern sea region.

One main goal of the expedition was to collect comprehensive oceanographic data on the state of the thermohaline and dynamic water structure of the Laptev Sea in the summer of 1993. Another goal was to obtain data on the mesoscale thermohaline water structure in the ice edge area and, if possible, in the frontal zone, that is formed during the interaction of the waters of the Lena river and the Laptev Sea.

Observation Program

The expedition program planned an oceanographic survey of the ice-free sea area with the distance between the stations being about 30 miles in the southern part of the sea (southward of 75° 30' N) and about 60 miles in the northern part of the sea. It was also planned to carry out high resolution studies in the area of the ice edge and at the border between river and sea waters. The distance between the stations was from 0.5 to 1 mile; the distance between the sections was about 1 mile.

Preliminary Results

In the course of the expedition, 90 hydrological stations of a large-scale survey and 20 stations at two sections with a higher resolution in the ice edge area were carried out (Fig. 4) . The observations were made with a low-inertial sounding CTD-"Pole" set with a 5 cm vertical resolution. On the basis of the shipboard analyses of vertical profiles, T-S diagrams, and maps of horizontal distribution of temperature and salinity (Fig. 11, 12, 13, 14), 5 typical regions of temperature and salinity distribution were determined:

- the area eastward of the Taymyr peninsula (region 1: Station IK 9335, 36, 58, 59, 60, 61);
- the area of the central sea (region 2: Station IK9354, 55, 56, 67, 68, 69);
- the area of the outflow of Lena river water (region 3: Station IK9321, 22, 23, 31 ,31A, 32);
- the area of the Yana Bay (region 4: Station IK93Z5, 1, 2, 3, 4, 9);
- the area of the Bel'kovskiy Island (region 5, Station IK9350, 51, 52, 72, 73, 74).

Region 1 is characterized by a high salinity in the near bottom layer at depths of more than 25 m (about 34.5 ‰) and by a low temperature (about -1.8° C). In our opinion this indicates the presence of waters of winter origin, on which the summer processes of this region do not have any influence. At this time (second decade of August) the surface layer, which is under the influence of active ice melting, has a salinity of about 15 ‰ and a temperature of 4.5° C (Fig. 15, 16, 17). In the first decade of September, the near bottom layer of region 1 does not experience any considerable changes and preserves a high salinity and a low temperature, whereas in the surface layer water salinity increases to 24 ‰ and water temperature decreases to 0 to 1.5° C (Fig. 18, 19, 20).

The waters of the near bottom quasi-uniform layer of region 2 are about 15 m thick and have characteristic salinities close to 33 ‰ and temperatures of about -1.5° C. Probably these waters are genetically related with the surface waters of winter origin. The surface layer is characterized by a meridional salinity variability of 14 ‰ (in the east) to 26 ‰ (in the west). The temperature distribution in the surface layer differs from that of salinity since the former has a more complex character. This becomes apparent in the absence of a clear tendency of meridional change in temperature and in the presence of warm water intrusions in the layer of 10 to 20 m at some stations (Fig. 21, 22, 23).

Depths of 10 to 15 m prevail in region 3. As a rule, there is no deep quasi-uniform layer here. Salinity gradually increases with depth and has quite a wide range of values (from 17 ‰ to 28 ‰) spread over the whole region. The temperature of this layer varies from 0.5° C to -1.1° C depending on the location in the region. The typical feature of this region is the presence of a strongly desalinated surface layer of river water with minimal salinity values of 3 to 7 ‰ and a maximal temperature of 4 to 6° C. Station 32, which was situated at the north-western boundary of the described area, is an exception (Fig. 24, 25, 26).

Region 4 is located in a zone of mixed sea and river water, which is characterized by a quasi-uniformly desalinated surface layer. This layer has salinities of 9 to 12 ‰ and a temperature of 1 to 3° C. In areas with depths of more than 20 m, there is a quasi-uniform near-bottom layer with a salinity of about 30 ‰ and a temperature of -1.4° C (Fig. 27, 28, 29).

Region 5 reveals a large diversity of vertical profiles of water temperature and water salinity. Nevertheless, at least two quasi-uniform layers can be identified: a surface layer (from 0 to 7 m) with salinities of 11.5 to 20 ‰ and temperatures of 0.9 to 3° C, and a near bottom layer (from 4 to 11 m thick) with salinities of 26 to 32.5 ‰ and temperatures of -1.25 to 0.1° C. Between these

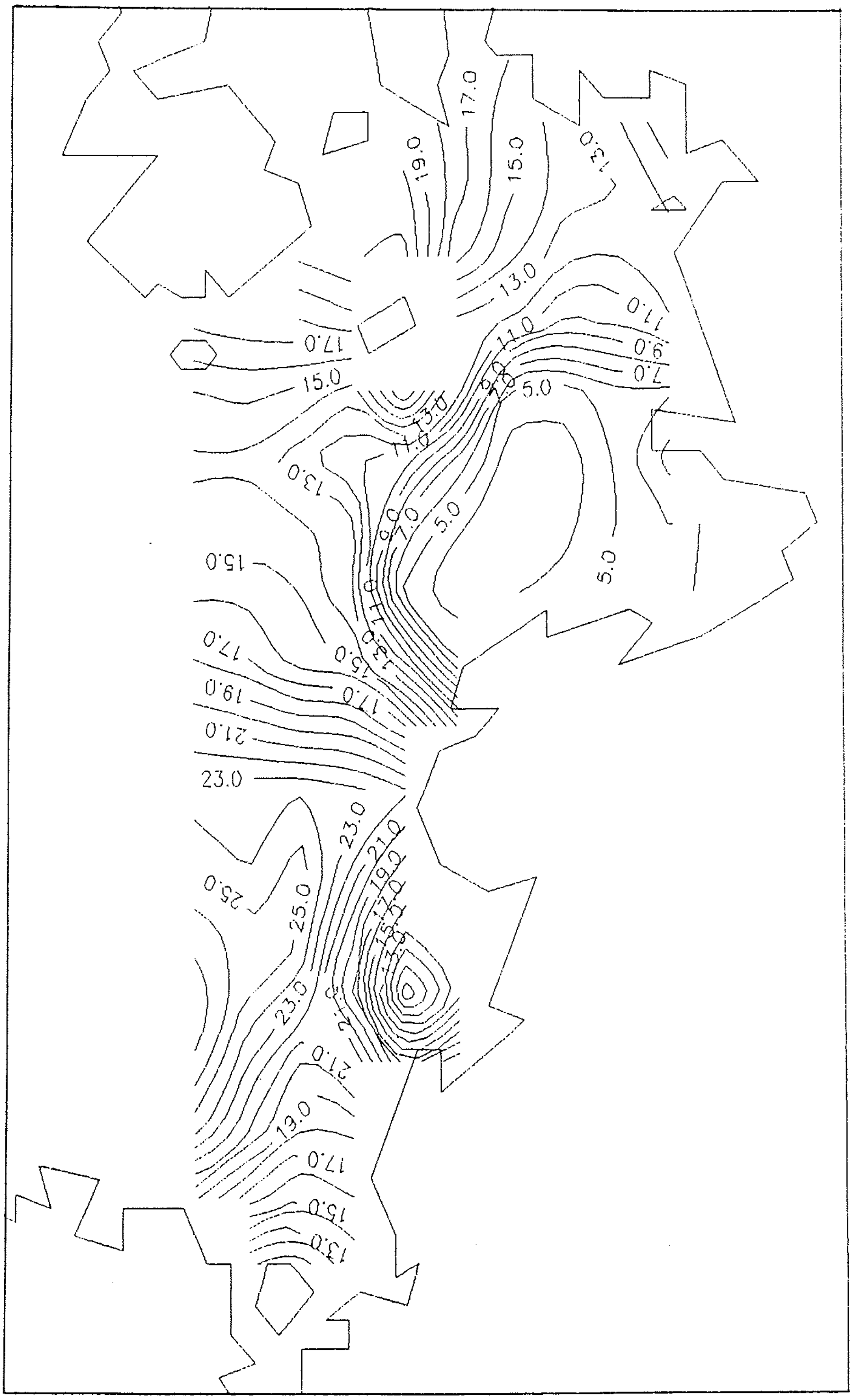


Fig. 11: Map of salinity distribution (‰, water depth 1 m.) August-September 1993

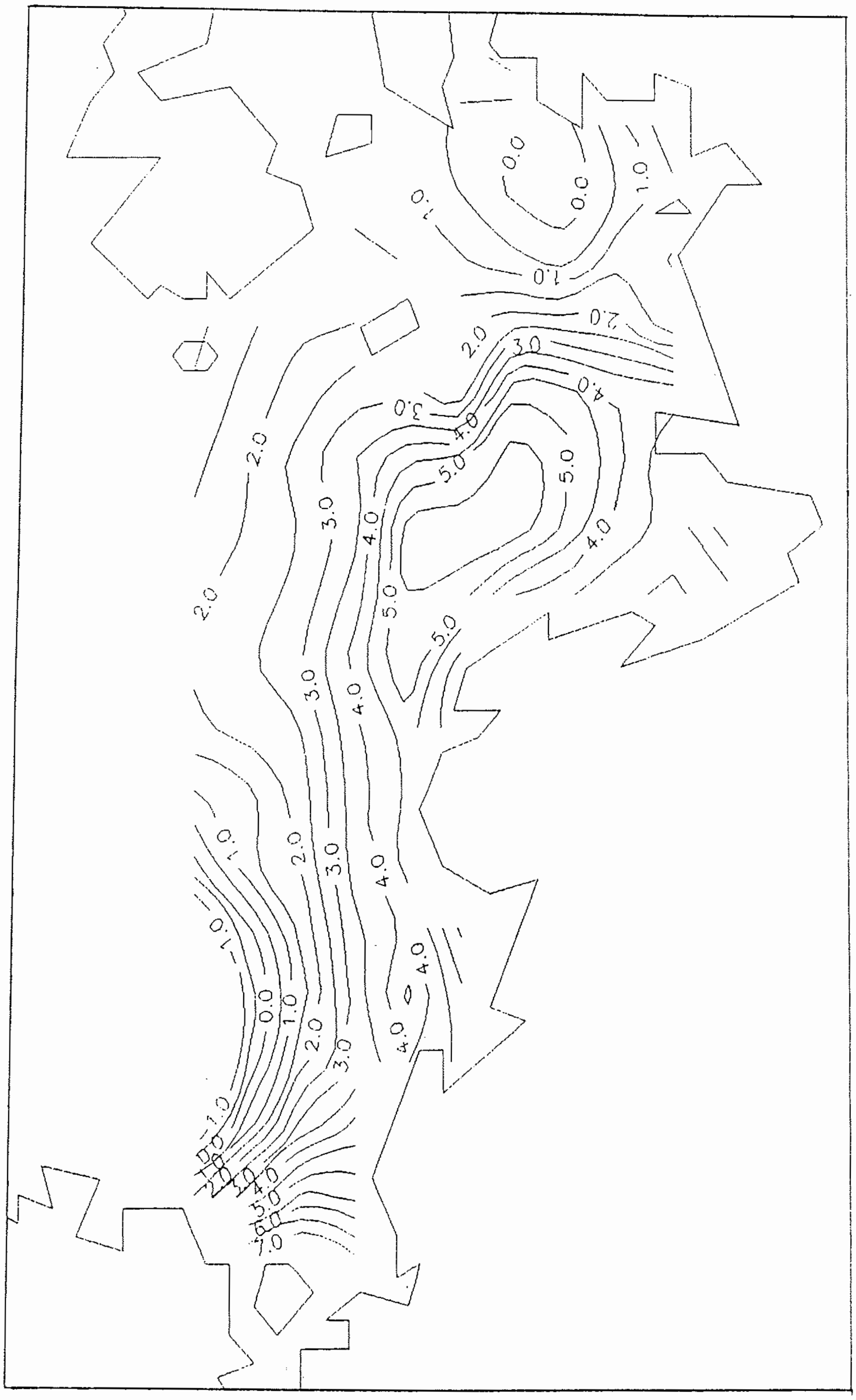


Fig. 12: Map of temperature distribution (°C, water depth 1 m.) August-September 1993

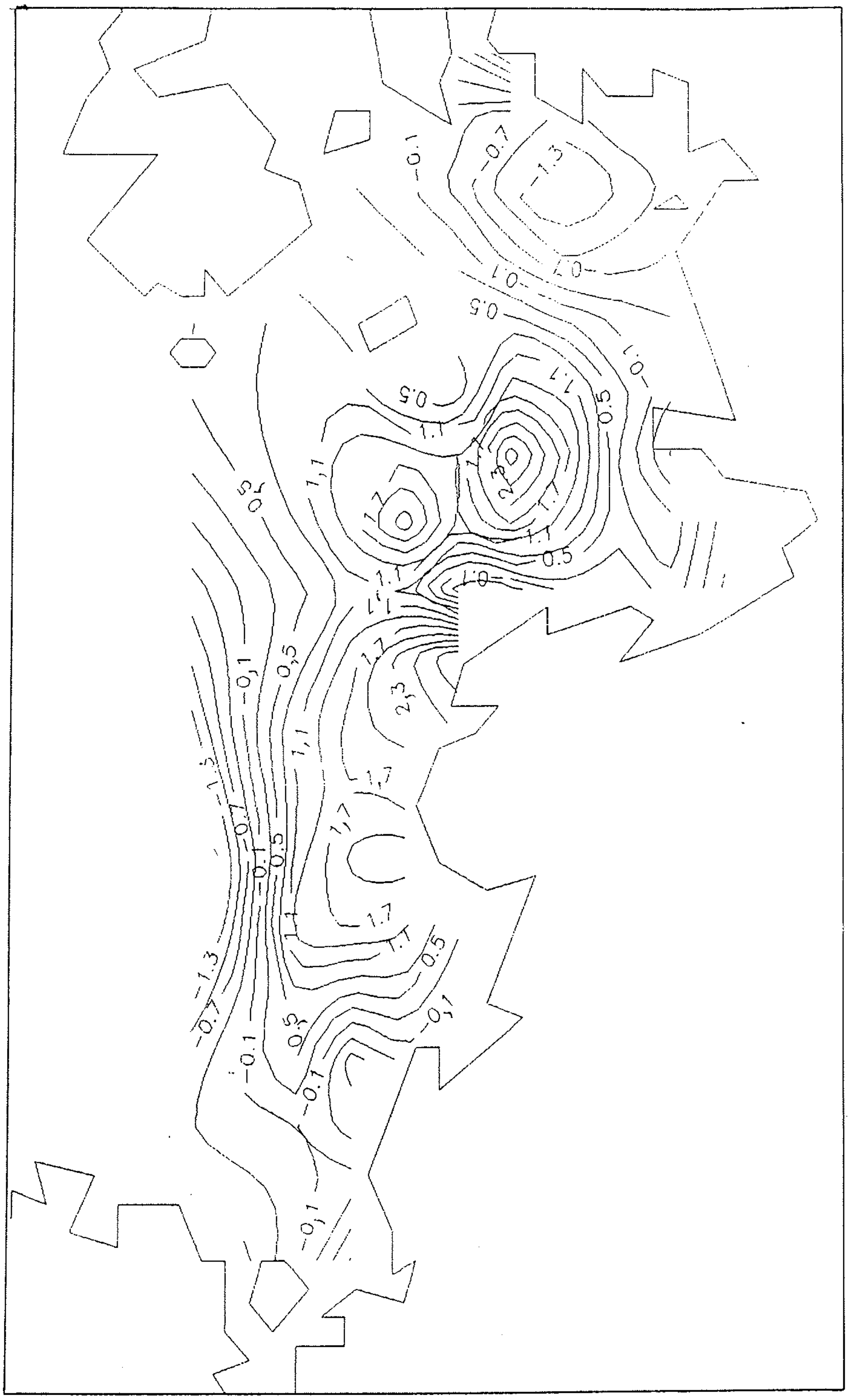


Fig. 13: Map of temperature distribution (°C, water depth 10 m.) August-September 1993

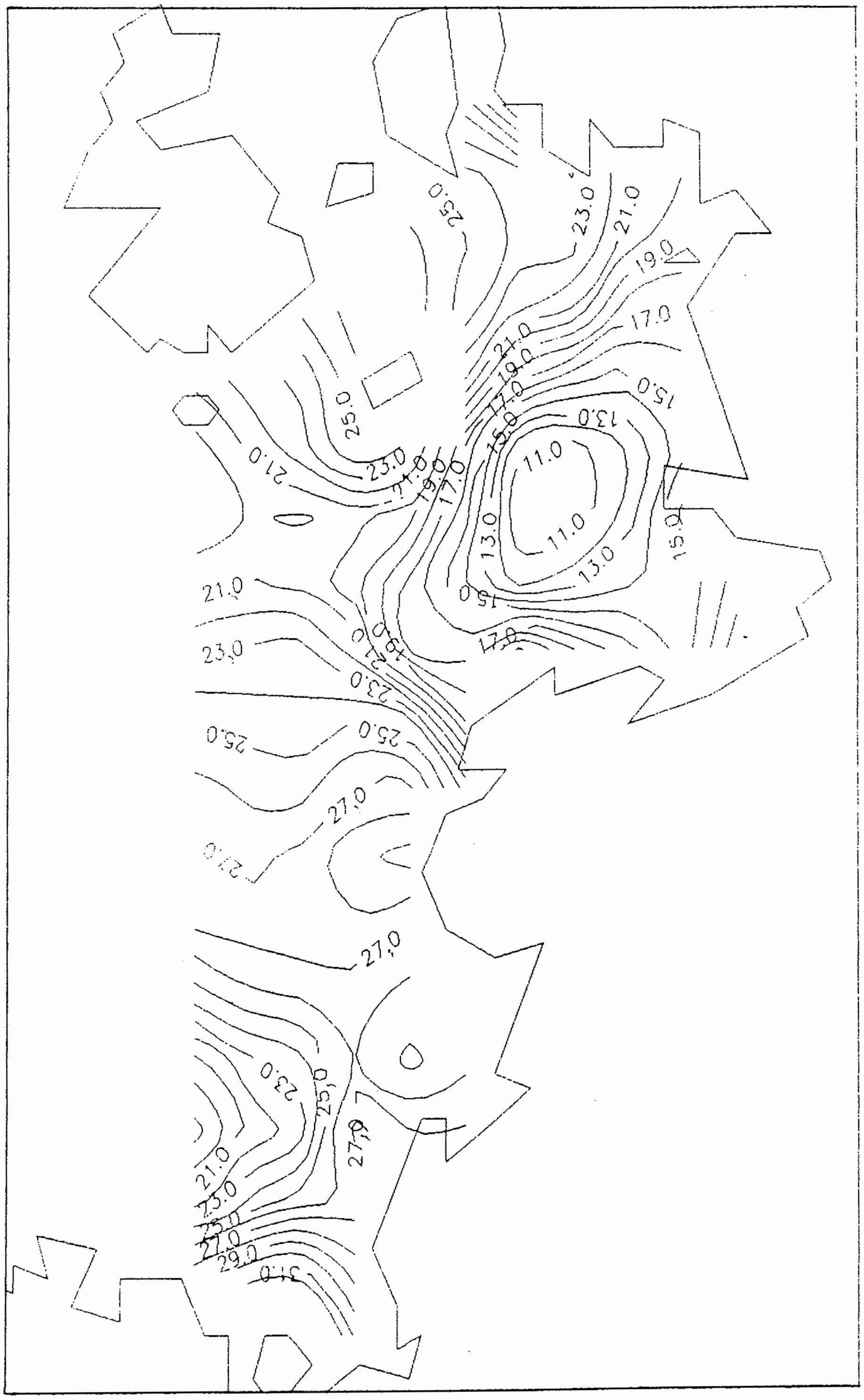


Fig. 14: Map of salinity distribution (‰, water depth 10 m.) August-September 1993

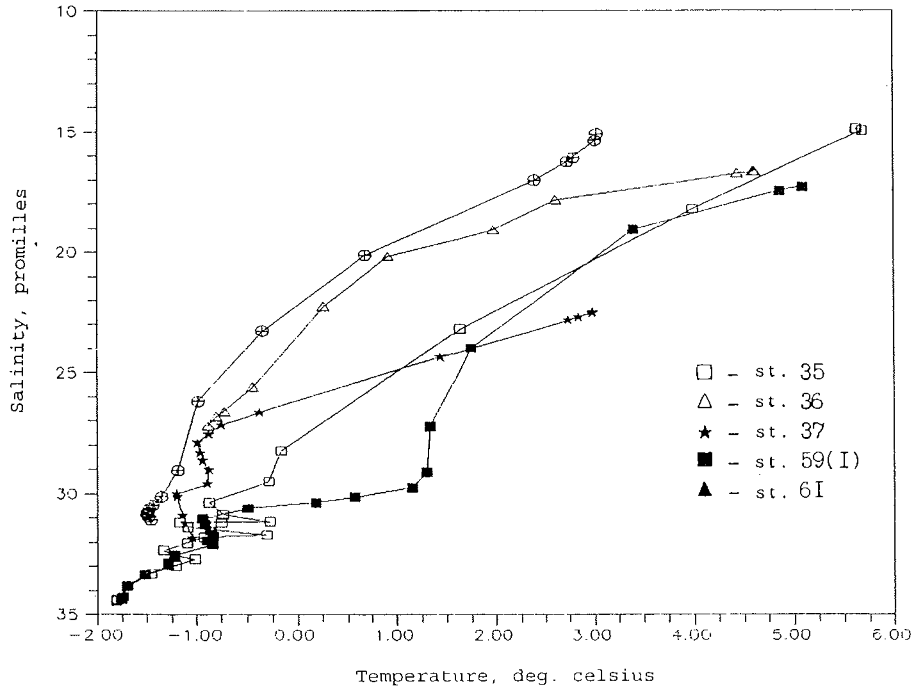


Fig. 15: T, S-diagram typical of the region 1 (August 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

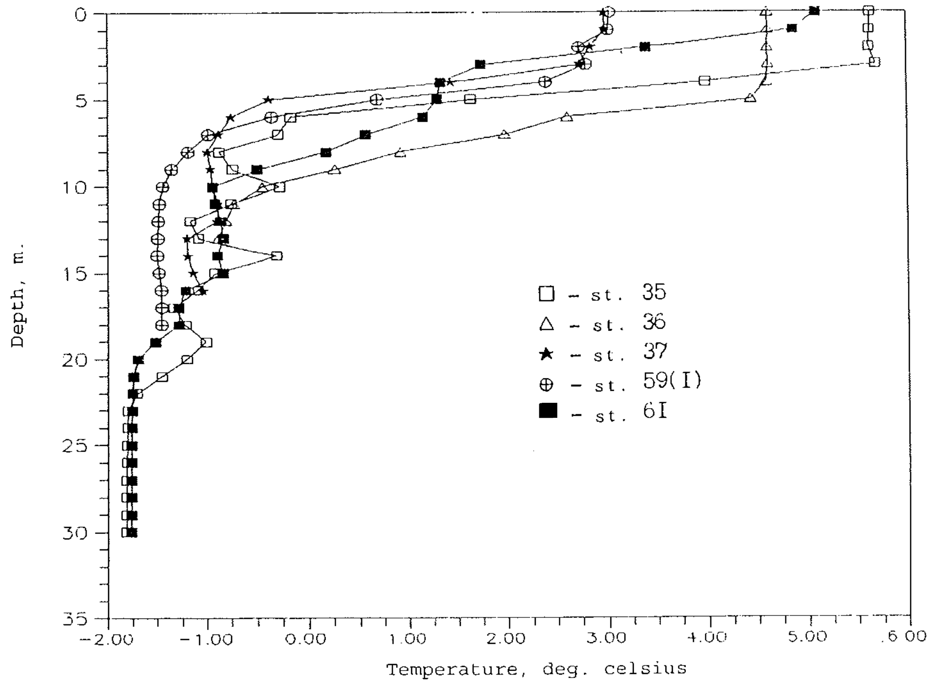


Fig. 16: Temperature profiles typical of the region 1 (August 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

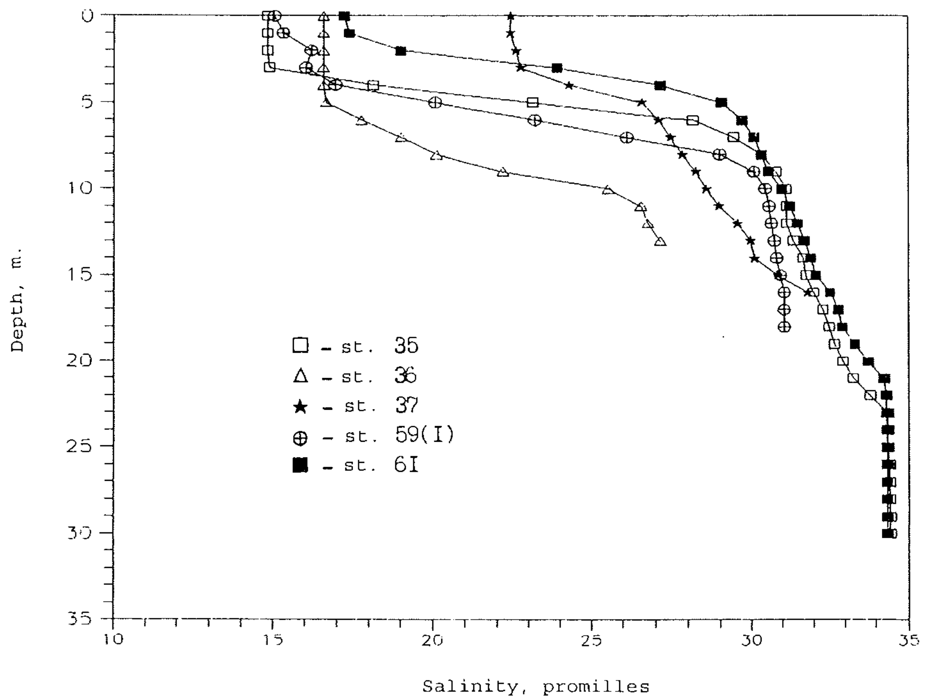


Fig. 17: Salinity profiles typical of the region 1 (August 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

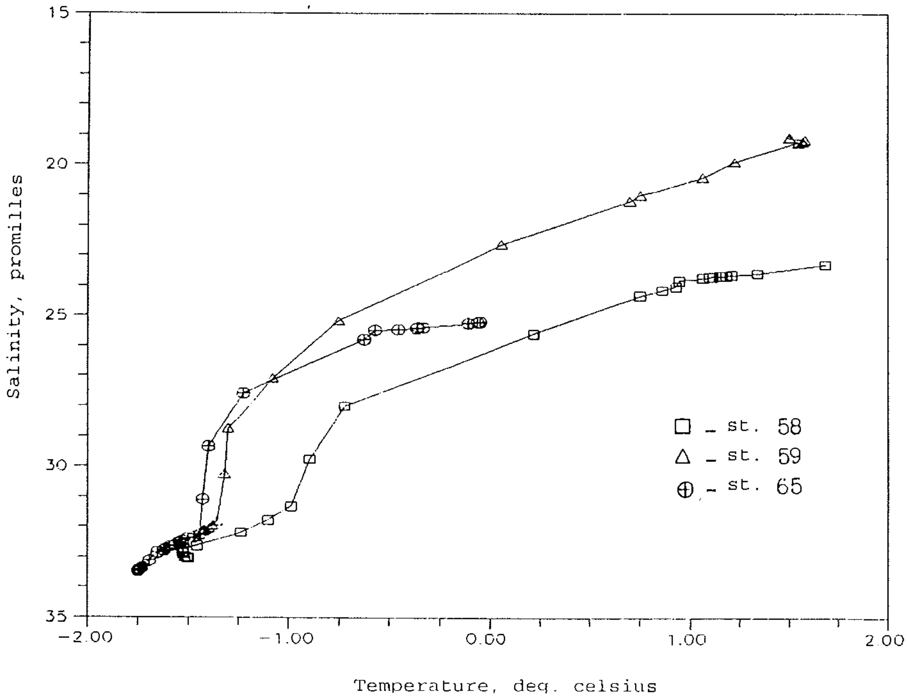


Fig. 18: T,S-diagram typical of the region 1 (September 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

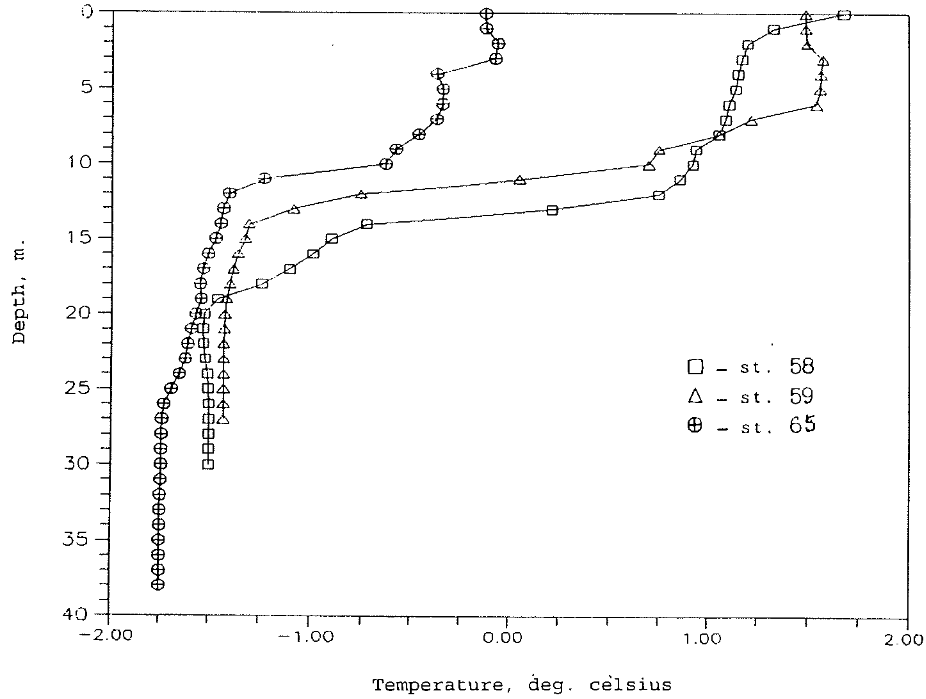


Fig. 19: Temperature profiles typical of the region 1 (September 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

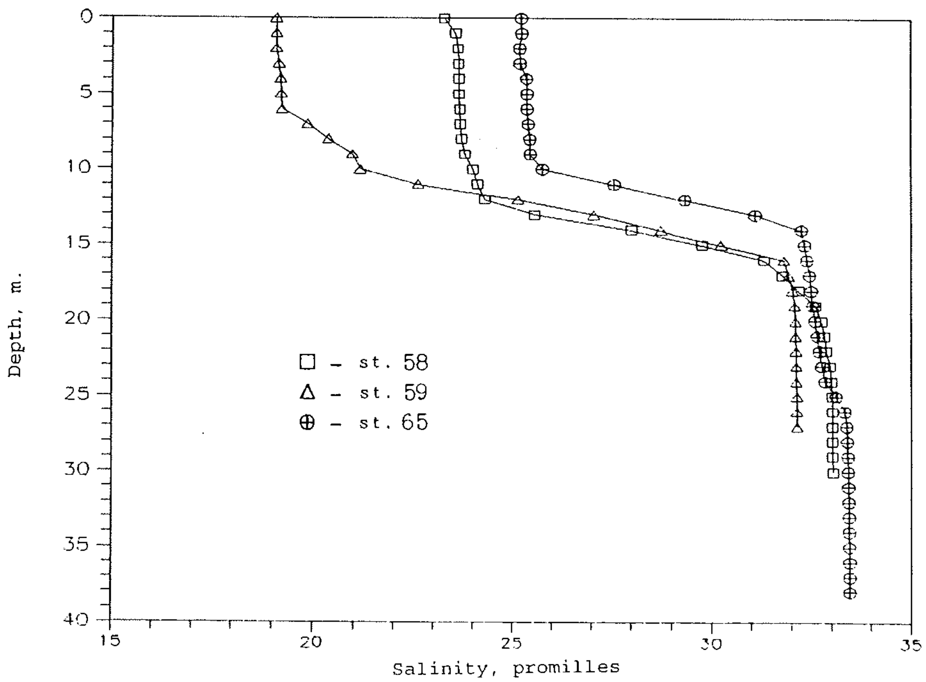


Fig. 20: Salinity profiles typical of the region 1 (September 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

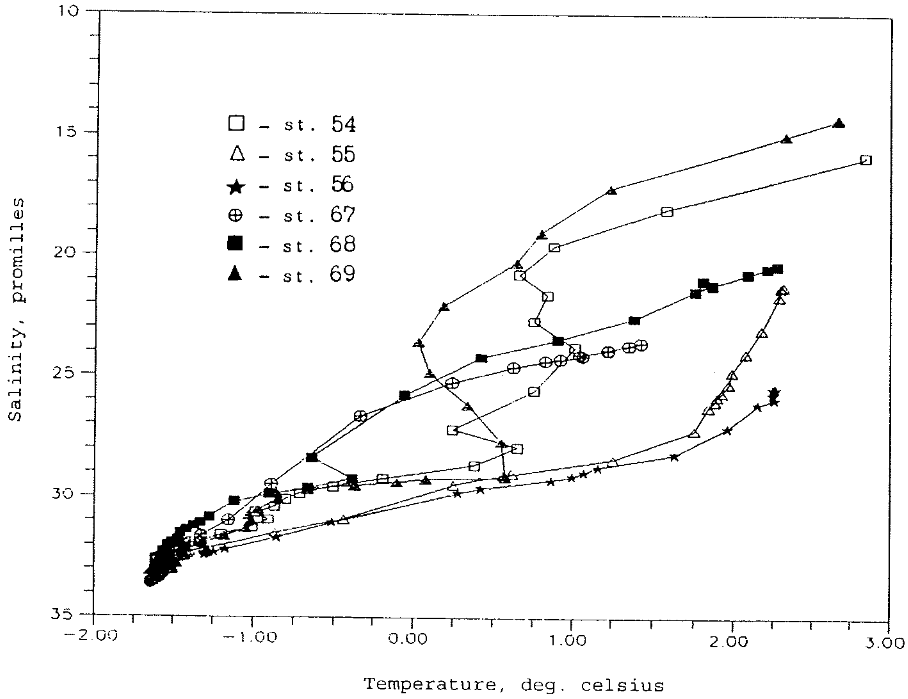


Fig. 21: T, S-diagram typical of the region 2 (September 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

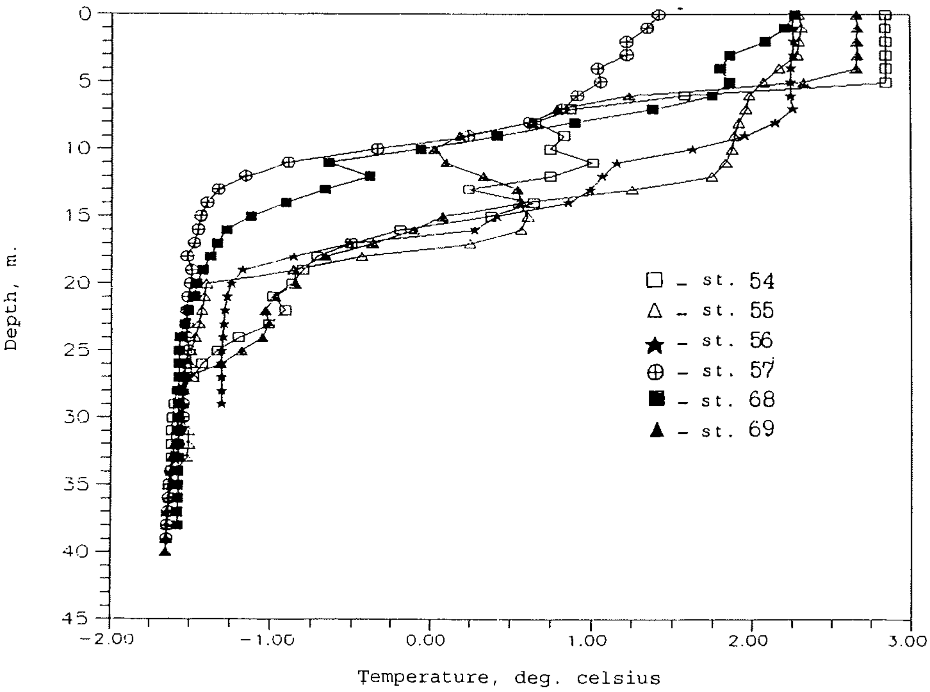


Fig. 22: Temperature profiles typical of the region 2 (September 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

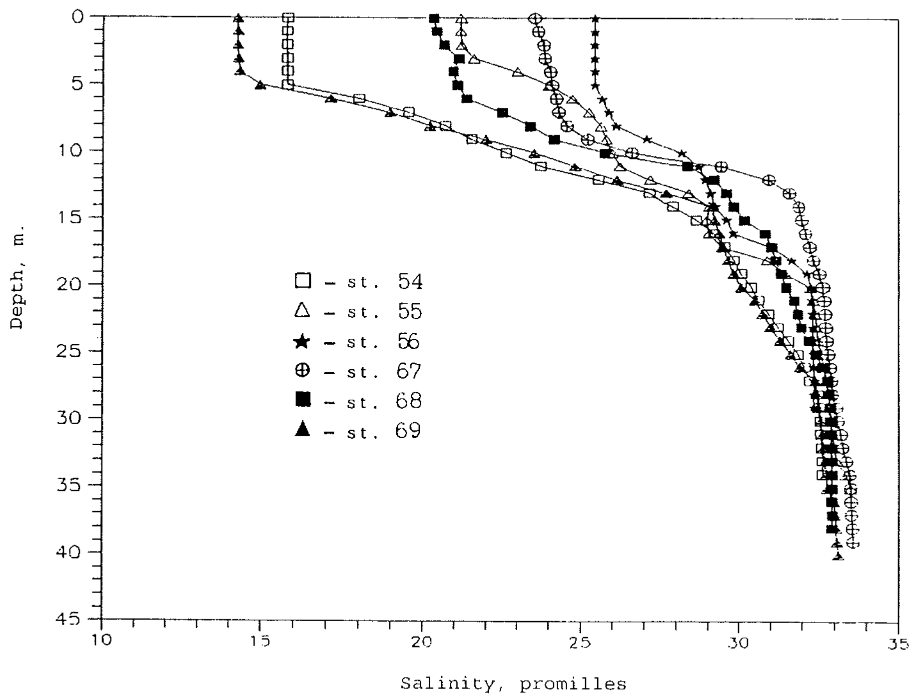


Fig. 23: Salinity profiles typical of the region 2 (September 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

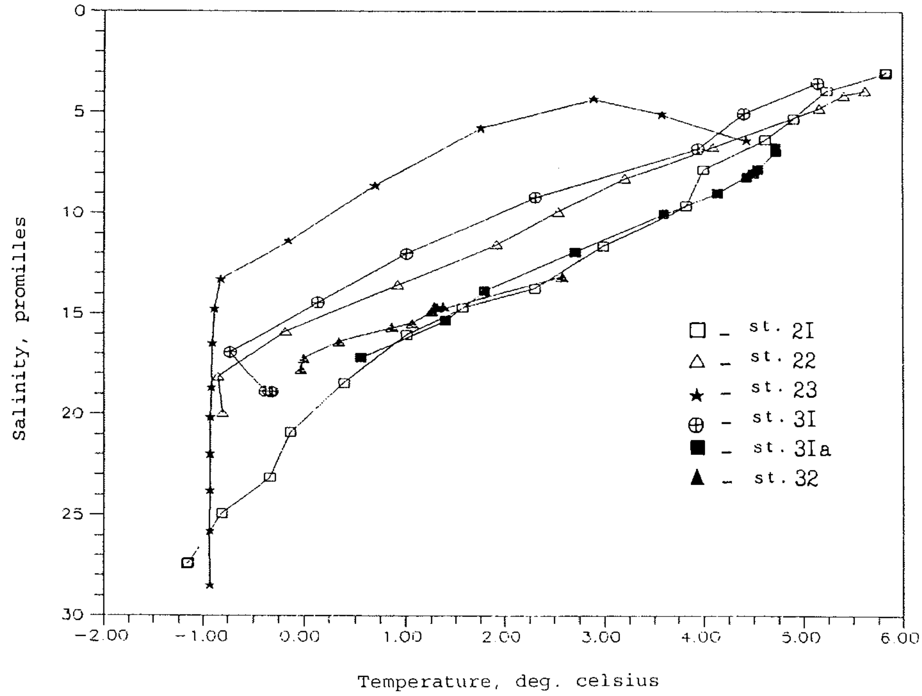


Fig. 24: T, S-diagram,typical of the region 3 (August 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

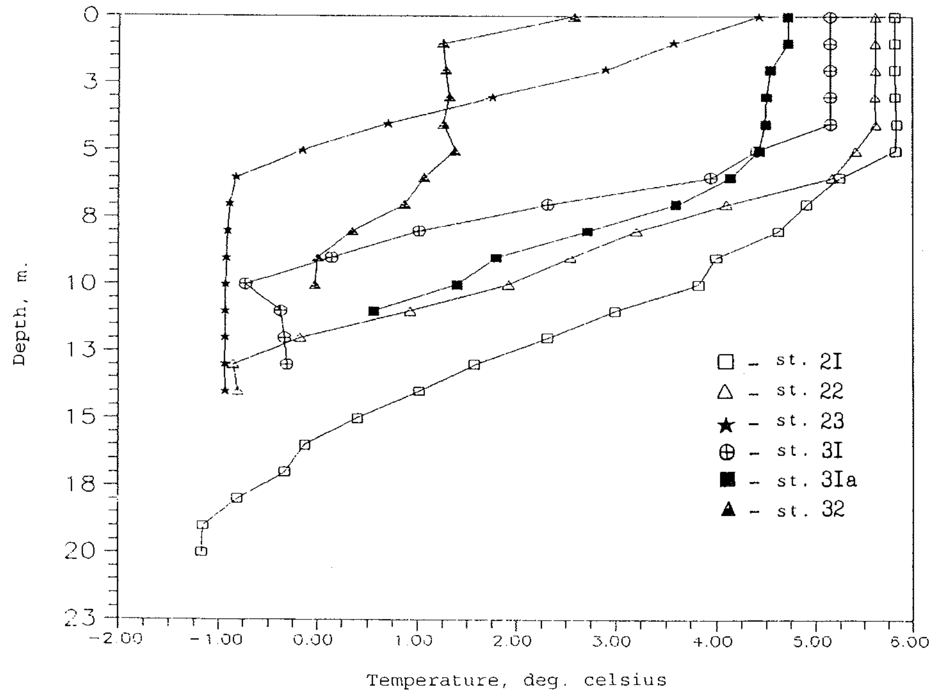


Fig. 25: Temperature profiles typical for the region 3 (August 1993 , TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

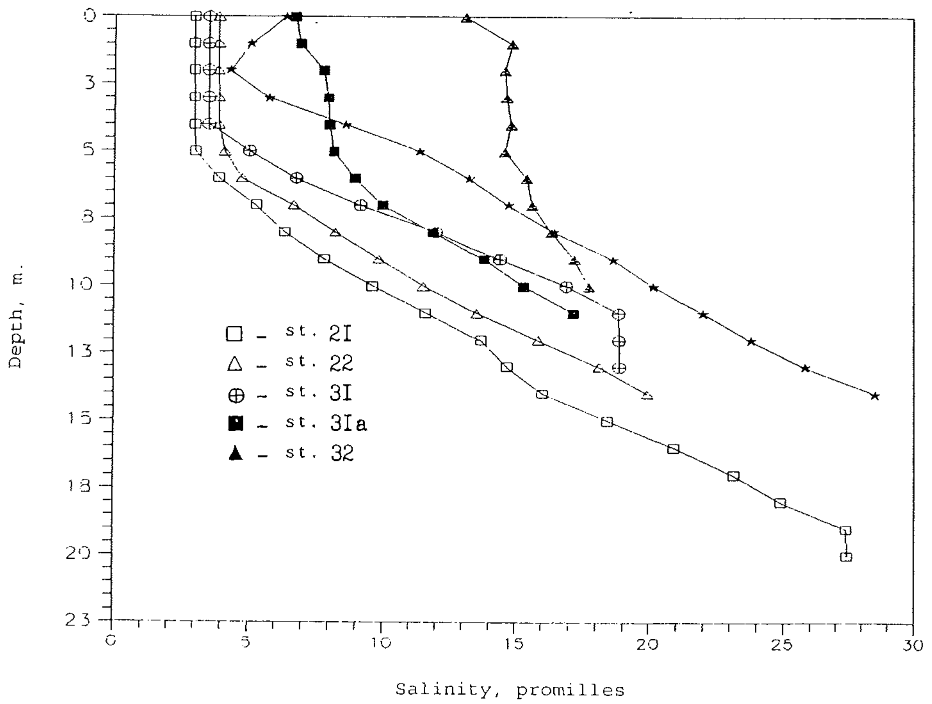


Fig. 26: Salinity profiles typical for the region 3 (August 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

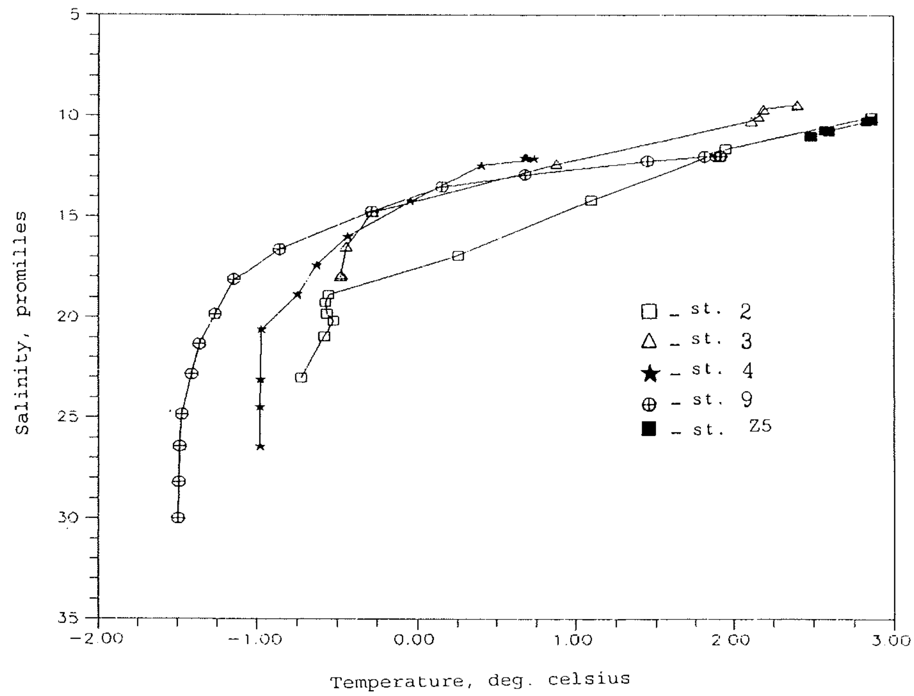


Fig. 27: T, S-diagram typical for the region 4 (August 1993 , TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

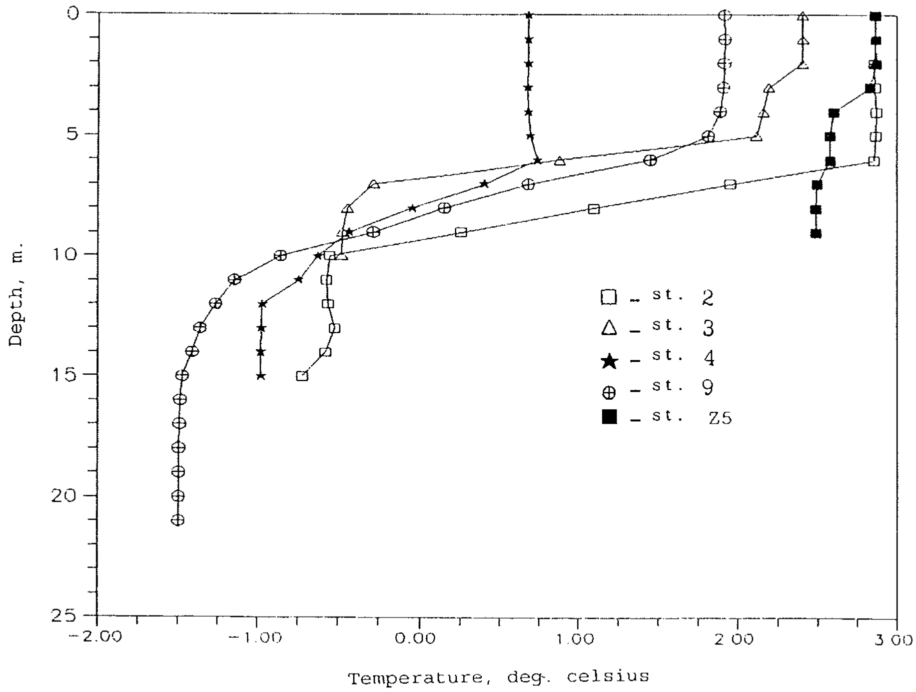


Fig. 28: Temperature profiles typical for the region 4 (August 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

layers the vertical temperature distribution has - in contrast to the salinity distribution - a complex character, which finds expression in the presence of temperature inversions (Fig. 30, 31, 32).

The distribution of water temperature and water salinity at the sections is determined by the described above features of the vertical thermohaline profiles of the different regions (large salinity and low temperature in the near bottom layer in the western sea, strong water desalination in the river run-off areas, complex character of temperature distribution in the central sea and in the area of the Bel'kovskiy Island). Large vertical salinity gradients are noted in the western sea and in the areas which are exposed to the effect of river run-off. The distributions of thermohaline characteristics at the sections are presented in figures 33 to 48.

Proposals

Since a detailed large-scale oceanographic survey of the sea takes very much time, it should not be included in complex expeditions, during which long-term geological and biological observations as well as analyses of the radionuclides of the sea water have to be carried out. During such expeditions the main focus of attention should be on special experiments and on polygon observations.

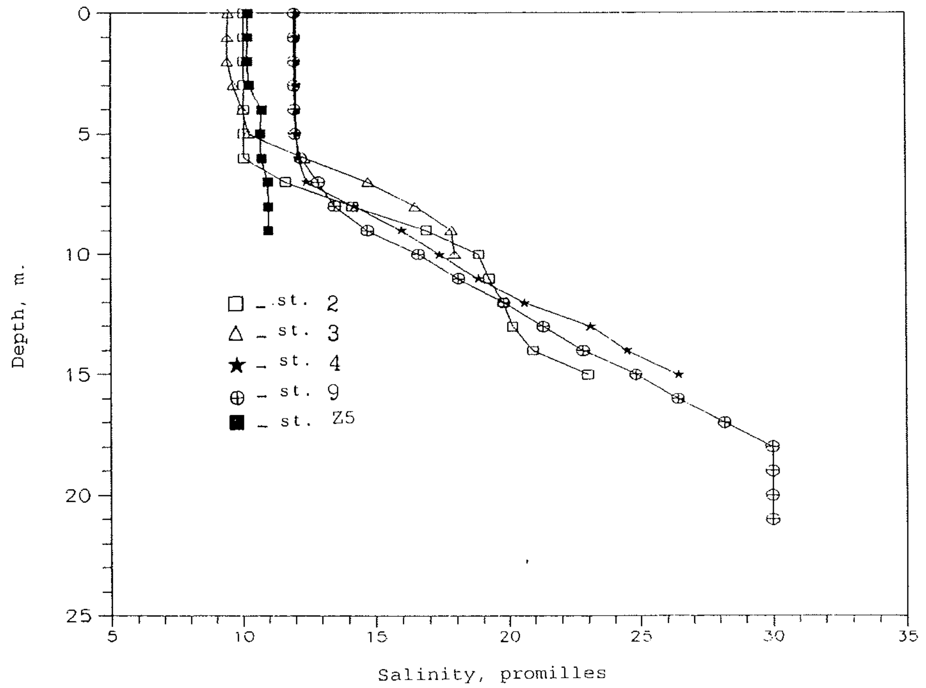


Fig. 29: Salinity profiles typical for the region 4 (August 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

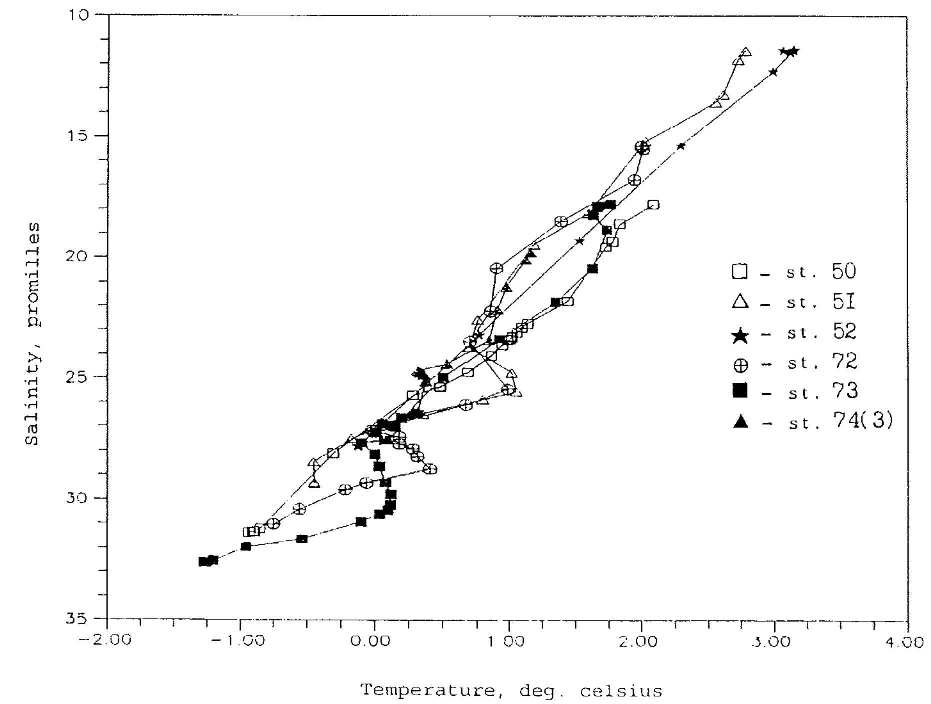


Fig. 30: T, S-diagram typical of the region 5 (September 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

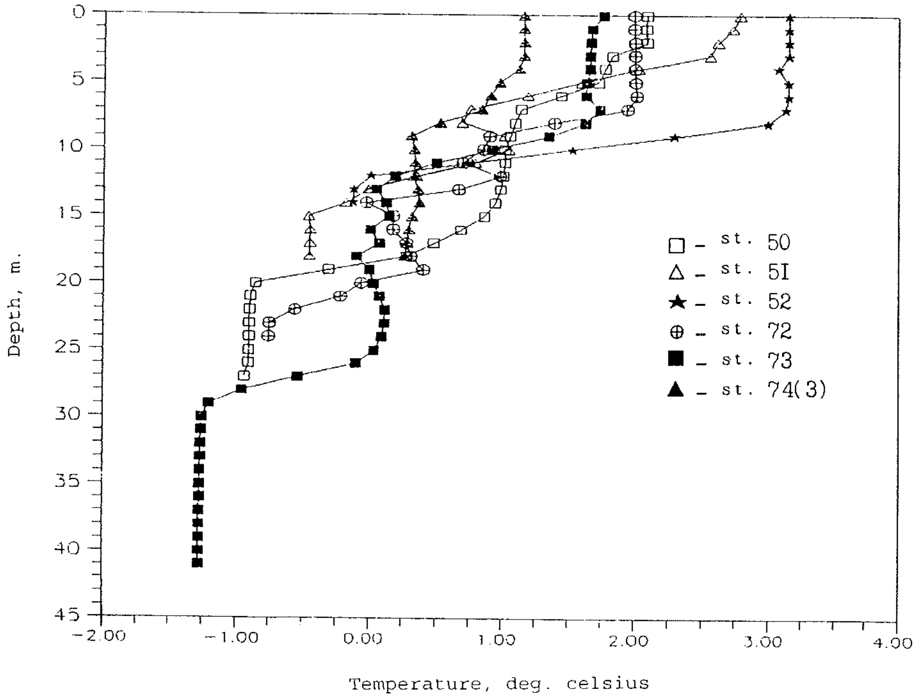


Fig. 31: Temperature profiles typical of the region 5 (September 1993, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

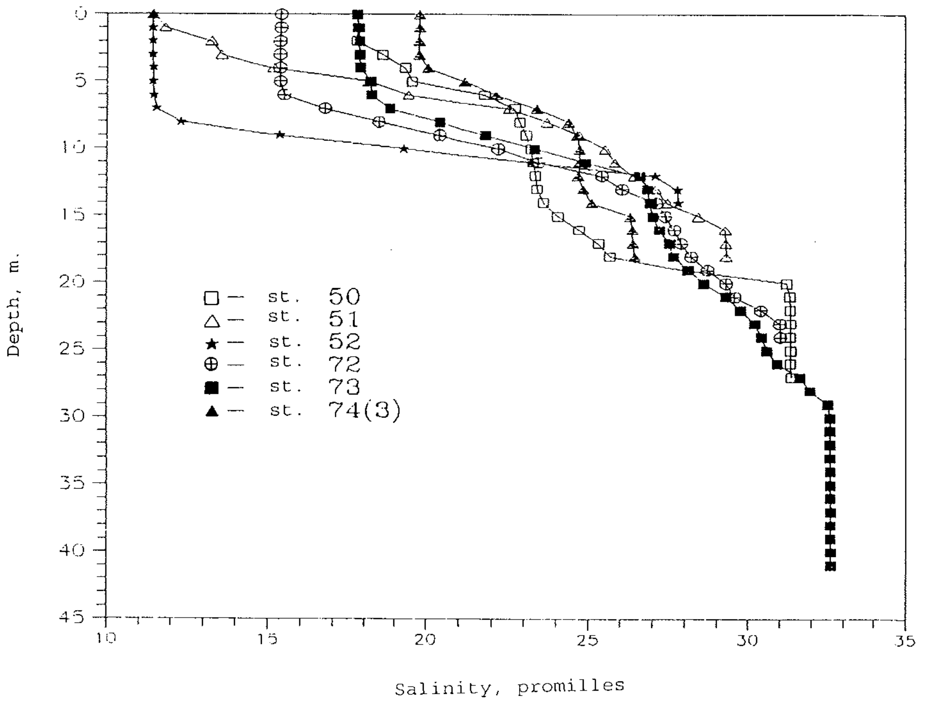


Fig. 32: Salinity profiles typical of the region 5 (September 1993 , TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

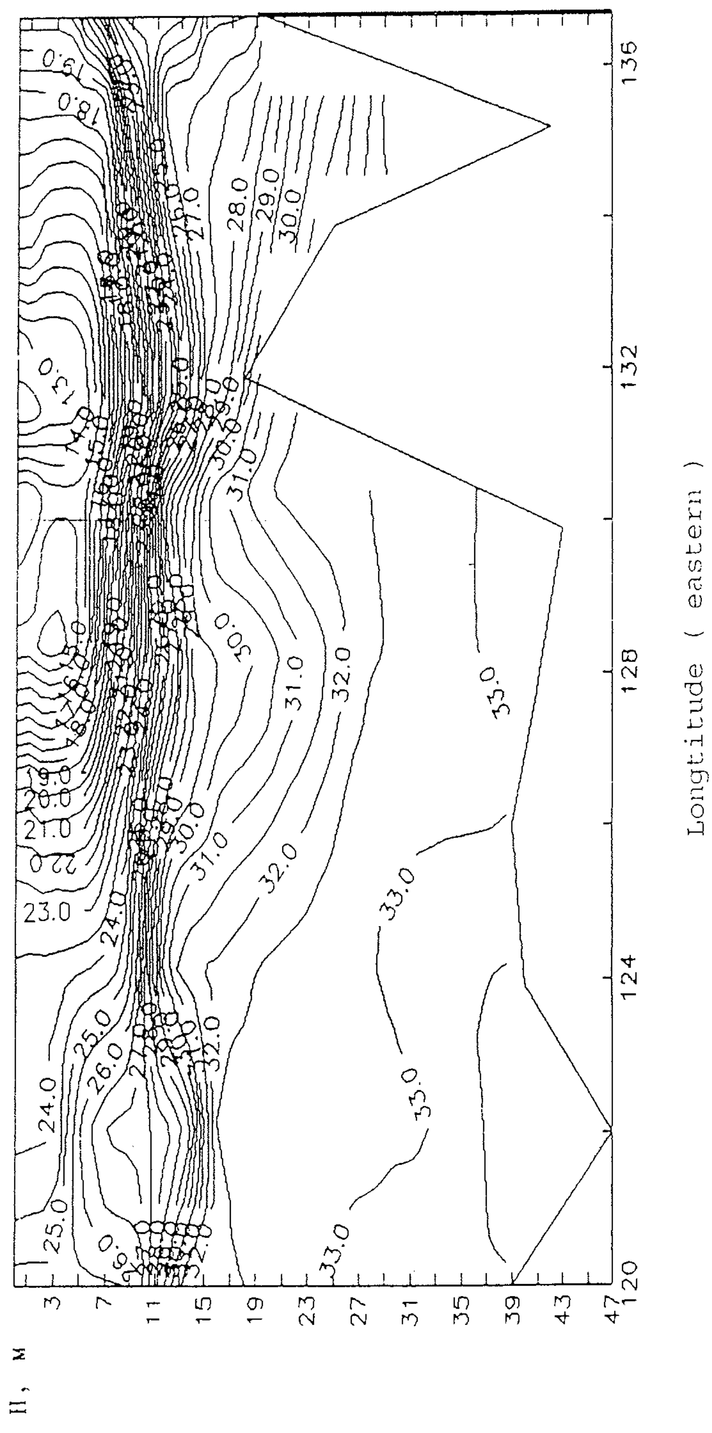


Fig. 33: Vertical salinity section (‰) along 75° 30´ N.L. (6-9.09.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

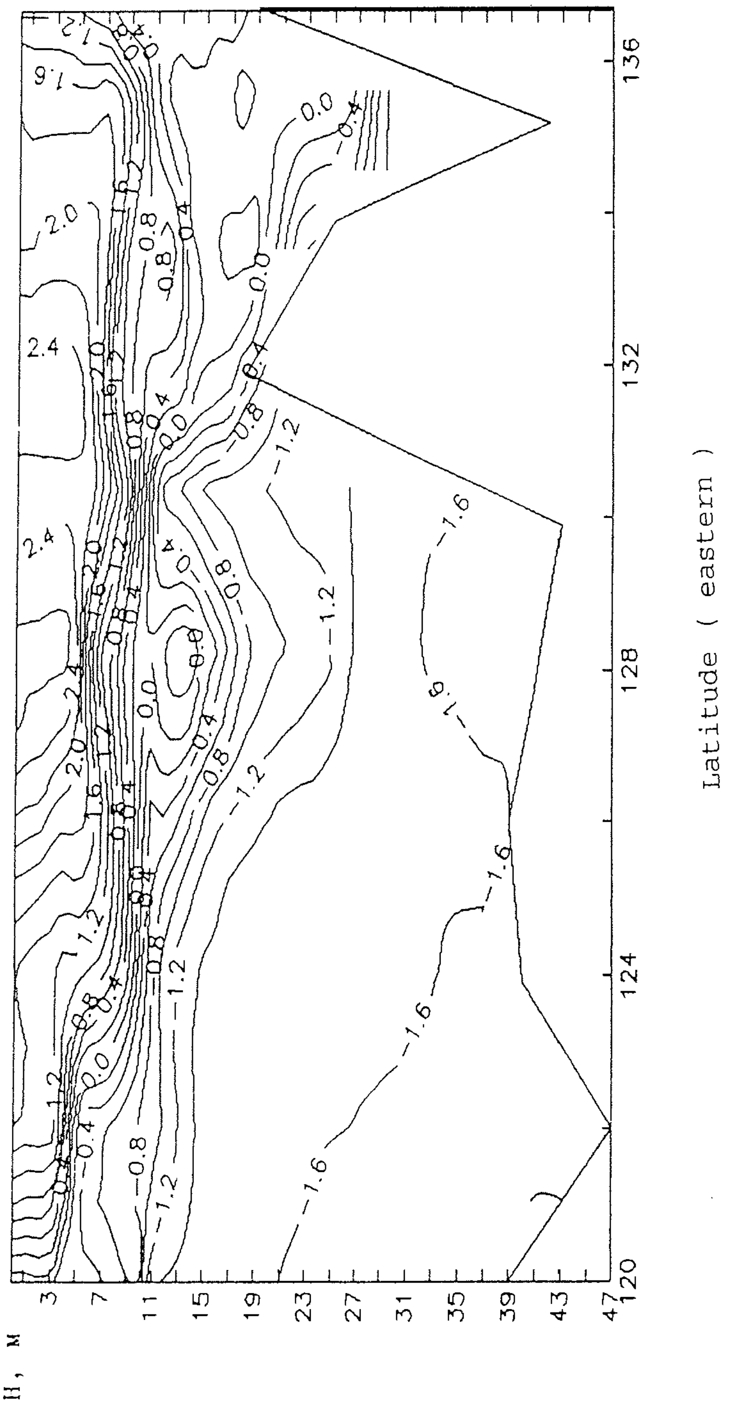


Fig. 34: Vertical temperature section (°C) along 75°30′ N.L. (6-9.09.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

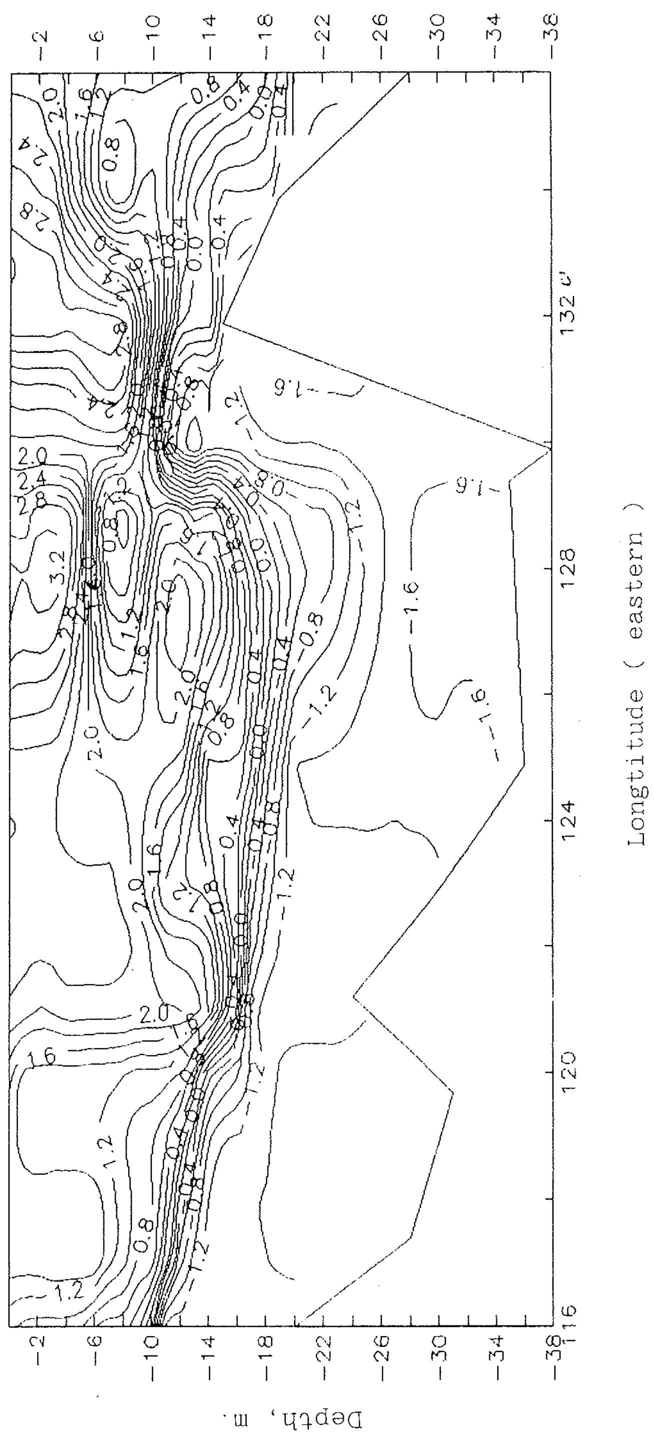


Fig. 35: Vertical temperature section (°C) along 75° N. L. (6-9.09.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

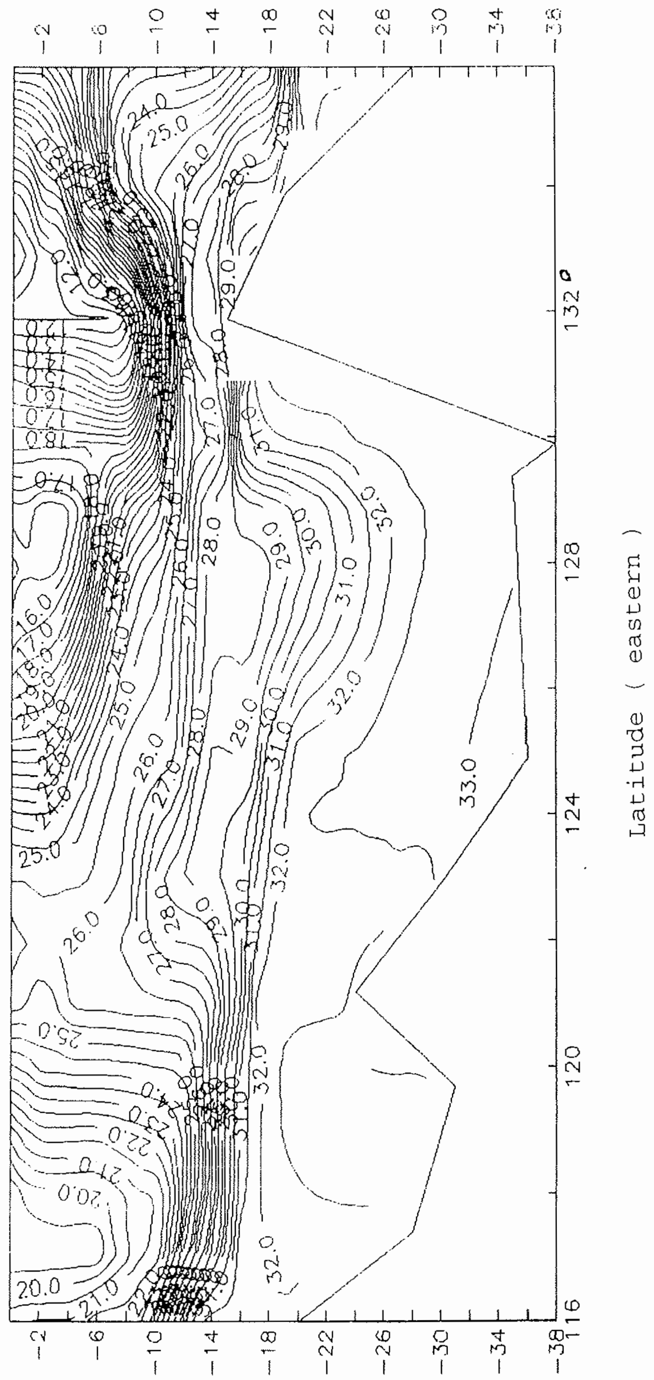


Fig. 36: Vertical salinity section (‰) along 75° N. L. (6-9.09.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

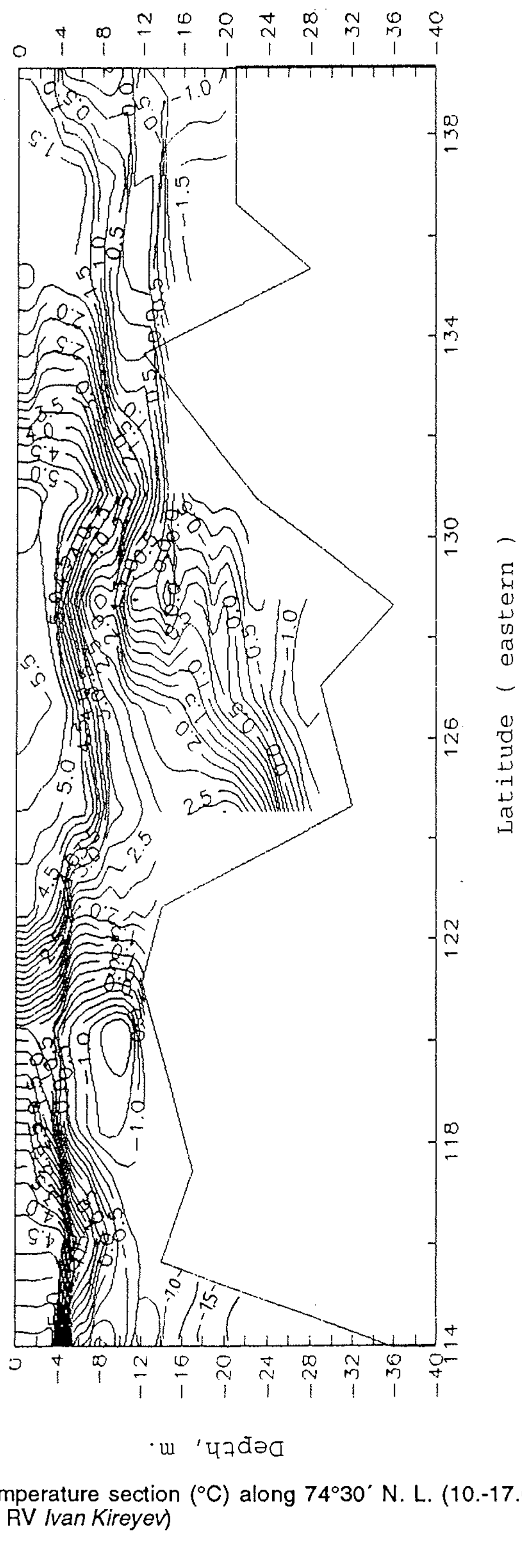


Fig. 37: Vertical temperature section (°C) along 74°30′ N. L. (10.-17.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

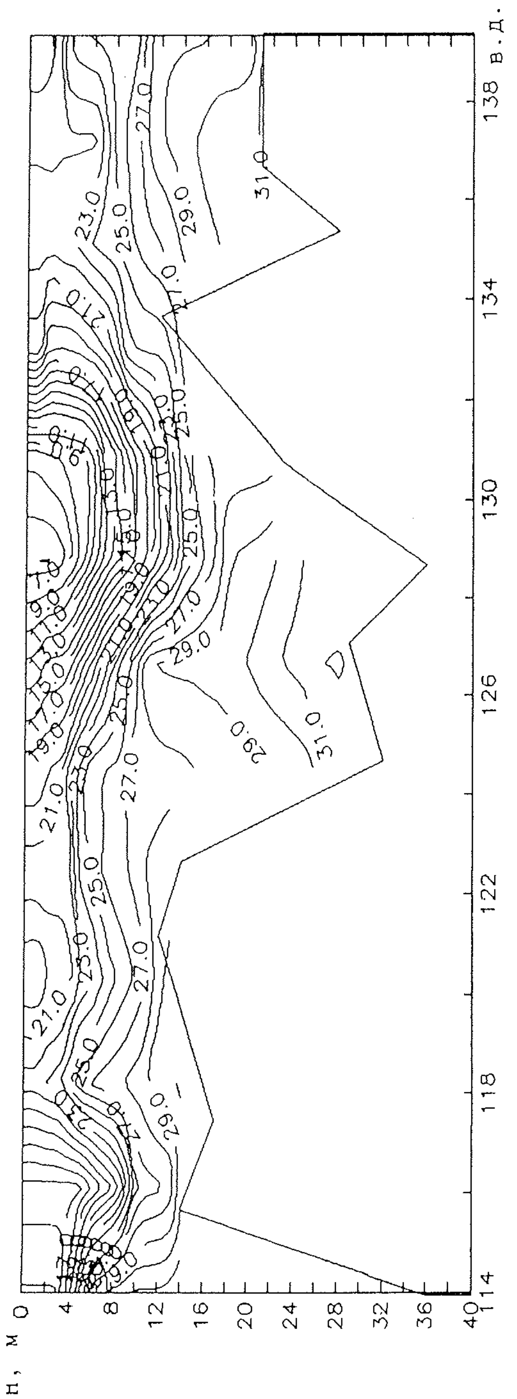


Fig. 38: Vertical salinity section (‰) along 74°30′ N.L. (10.-17.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

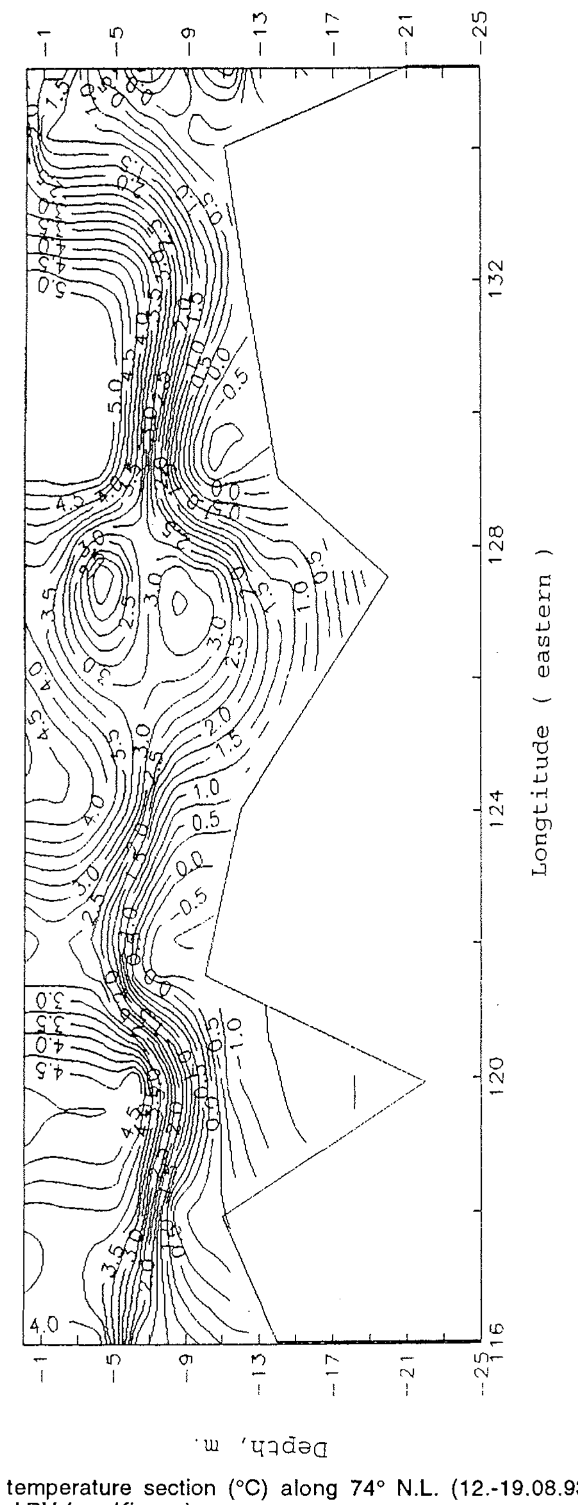


Fig. 39: Vertical temperature section (°C) along 74° N.L. (12.-19.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

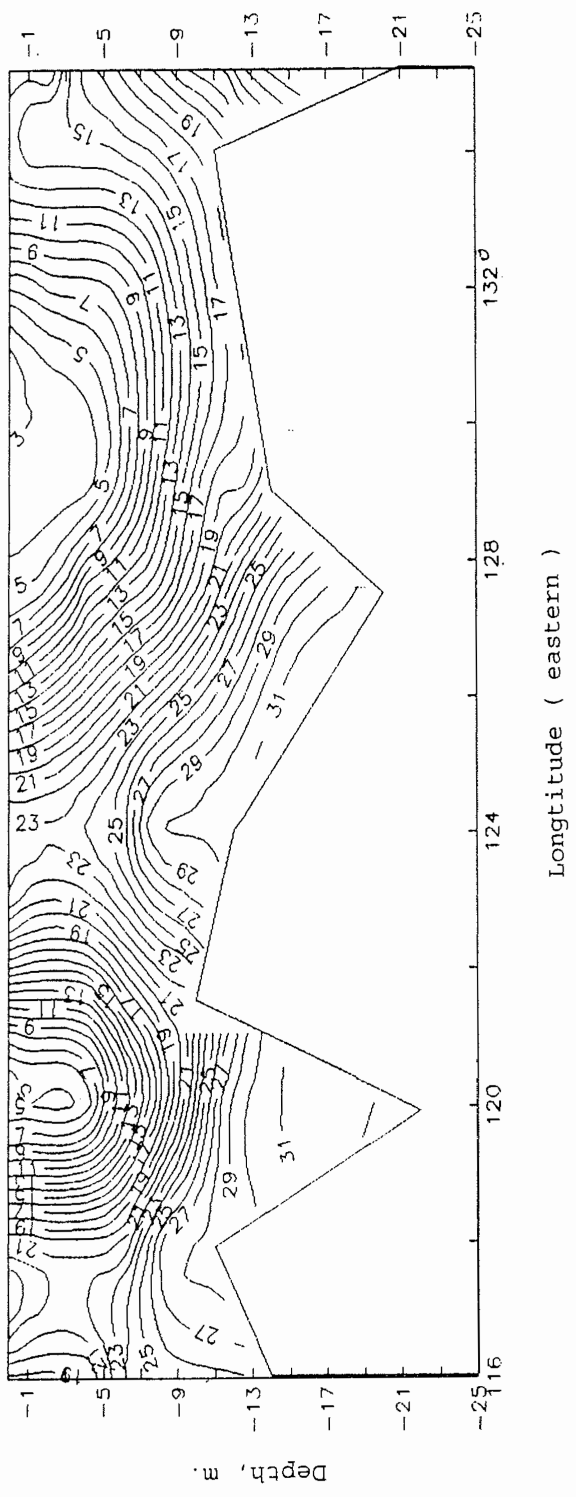


Fig. 40: Vertical salinity section (‰) along 74° N.L. (12.-19.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

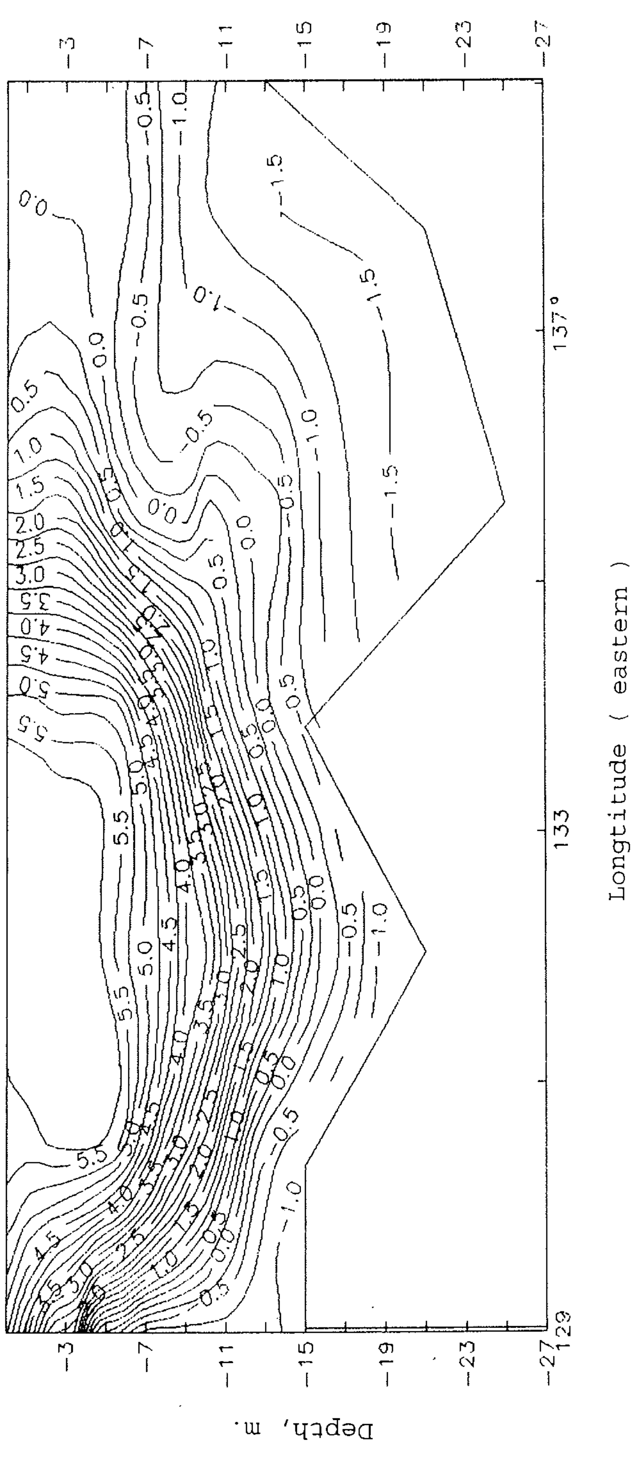


Fig. 41: Vertical temperature section (°C) along 73°30′ N.L. (20.-21.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

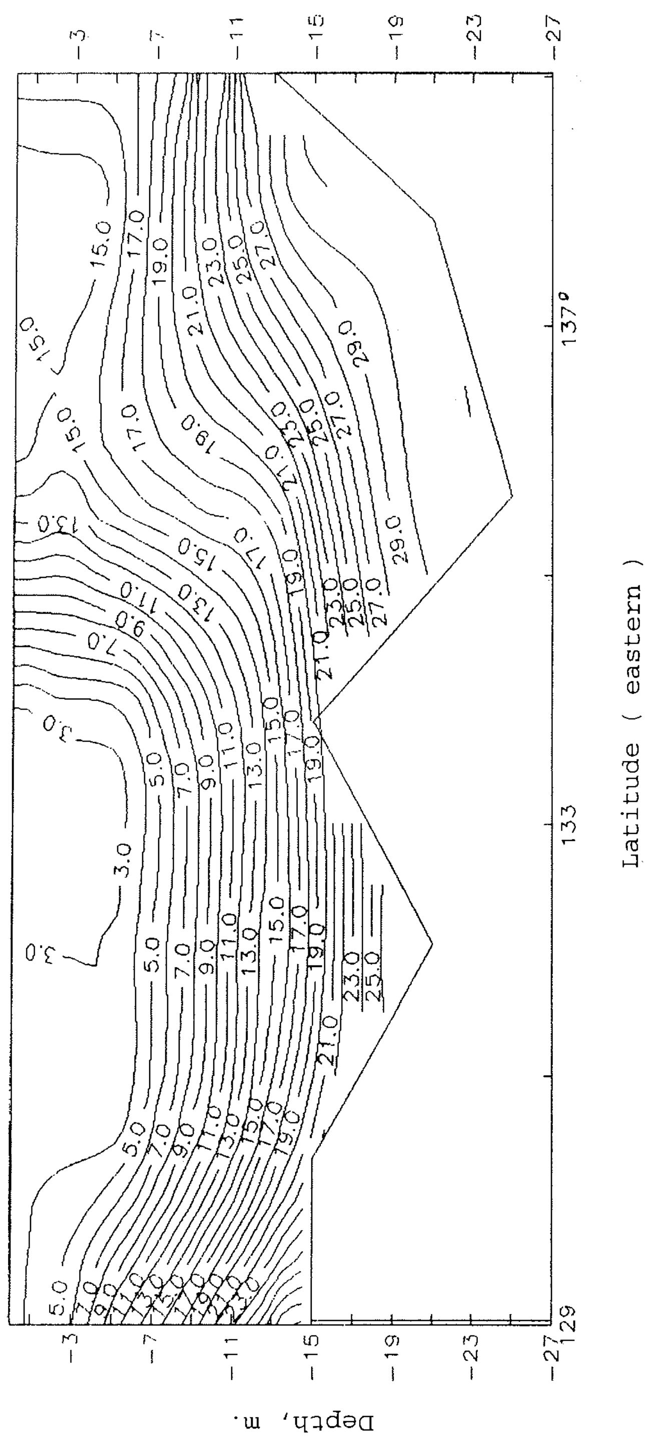


Fig. 42: Vertical salinity section (‰) along 73°30′ N.L. (20.-21.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

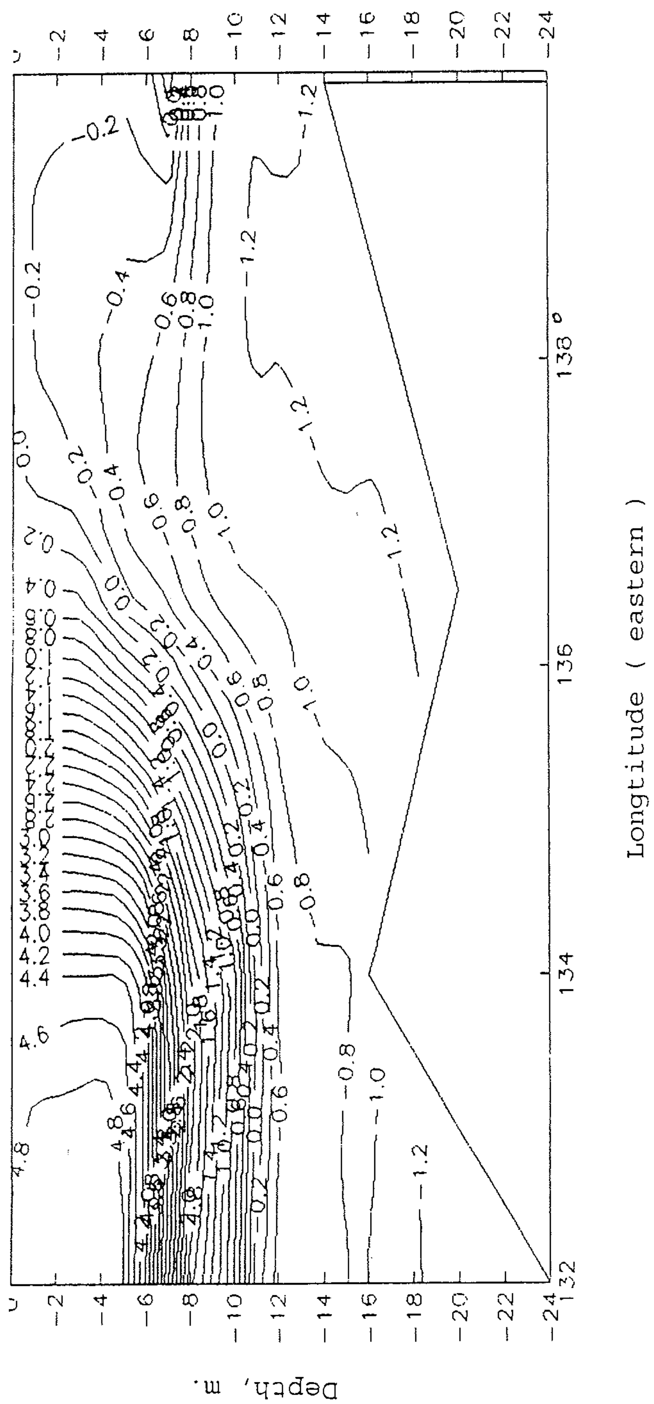


Fig. 43: Vertical temperature section (°C) along 73° N.L. (22.-23.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

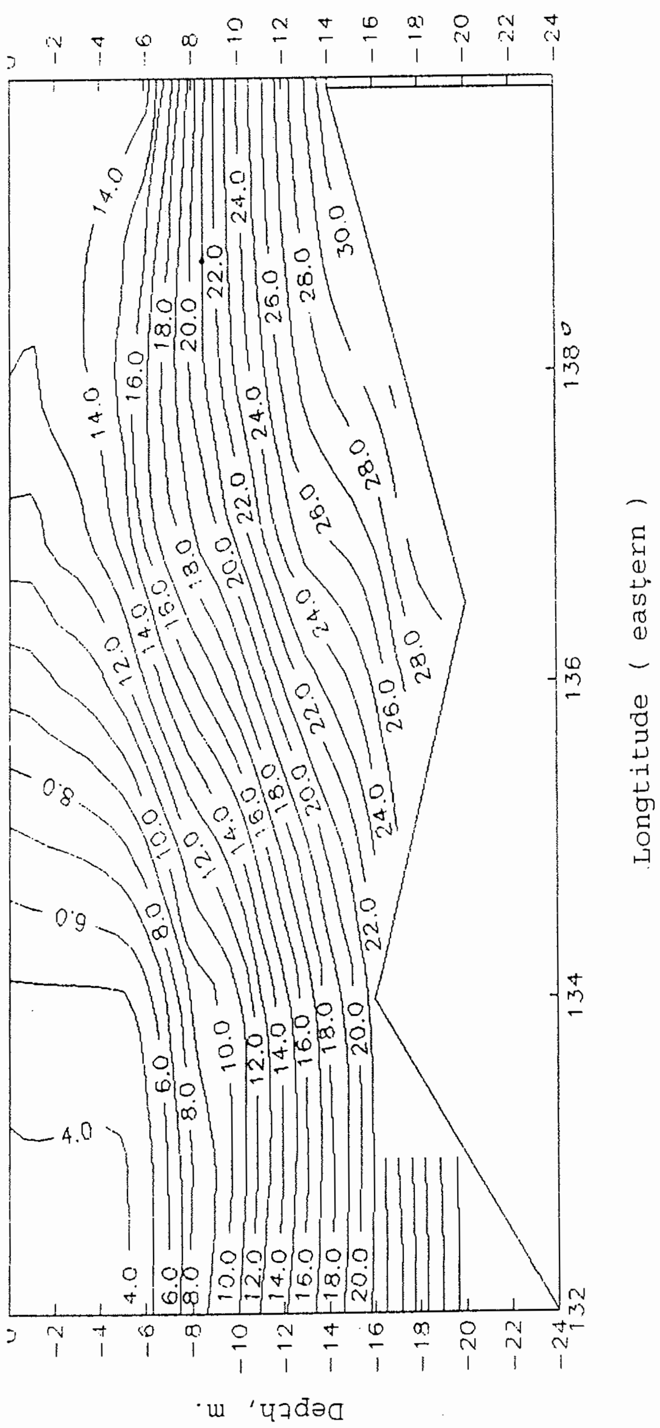


Fig. 44: Vertical salinity section (‰) along 73° N.L. (22.-23.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

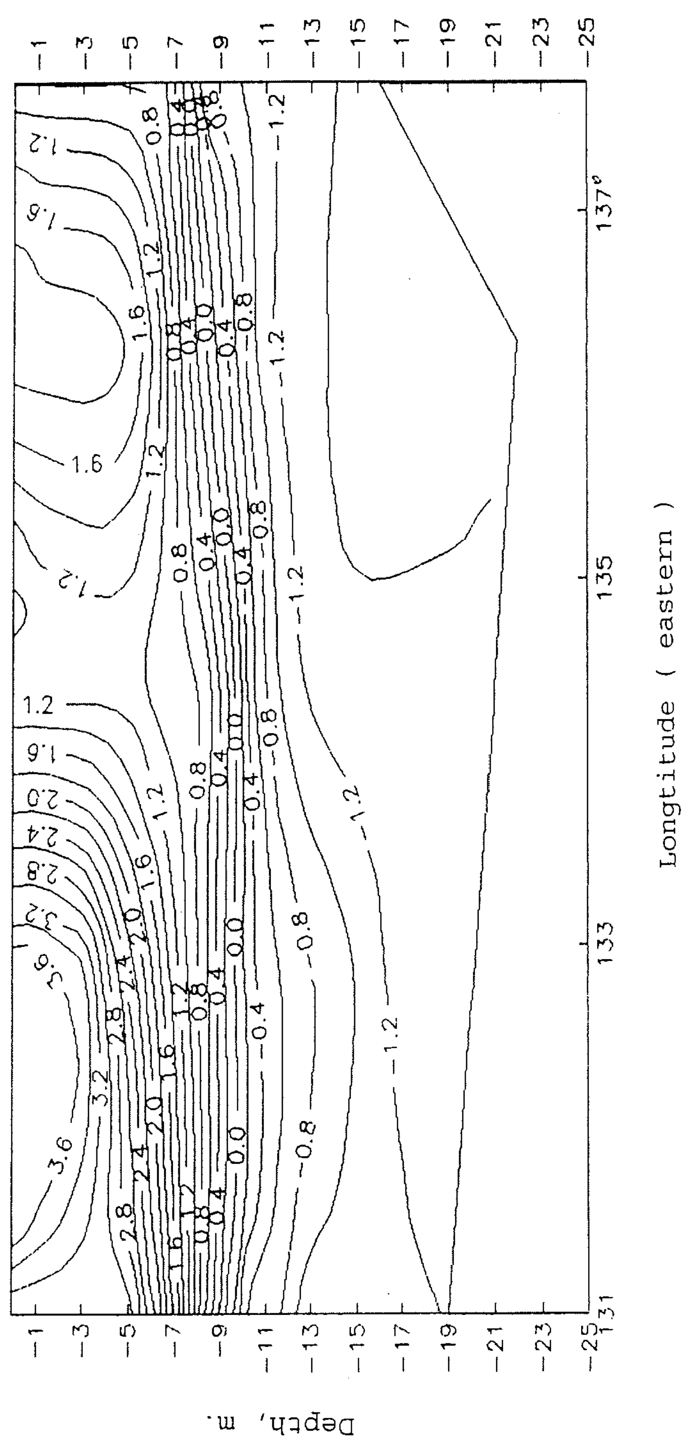


Fig. 45: Vertical temperature section (°C) along 72°30′ N.L. (29.-31.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

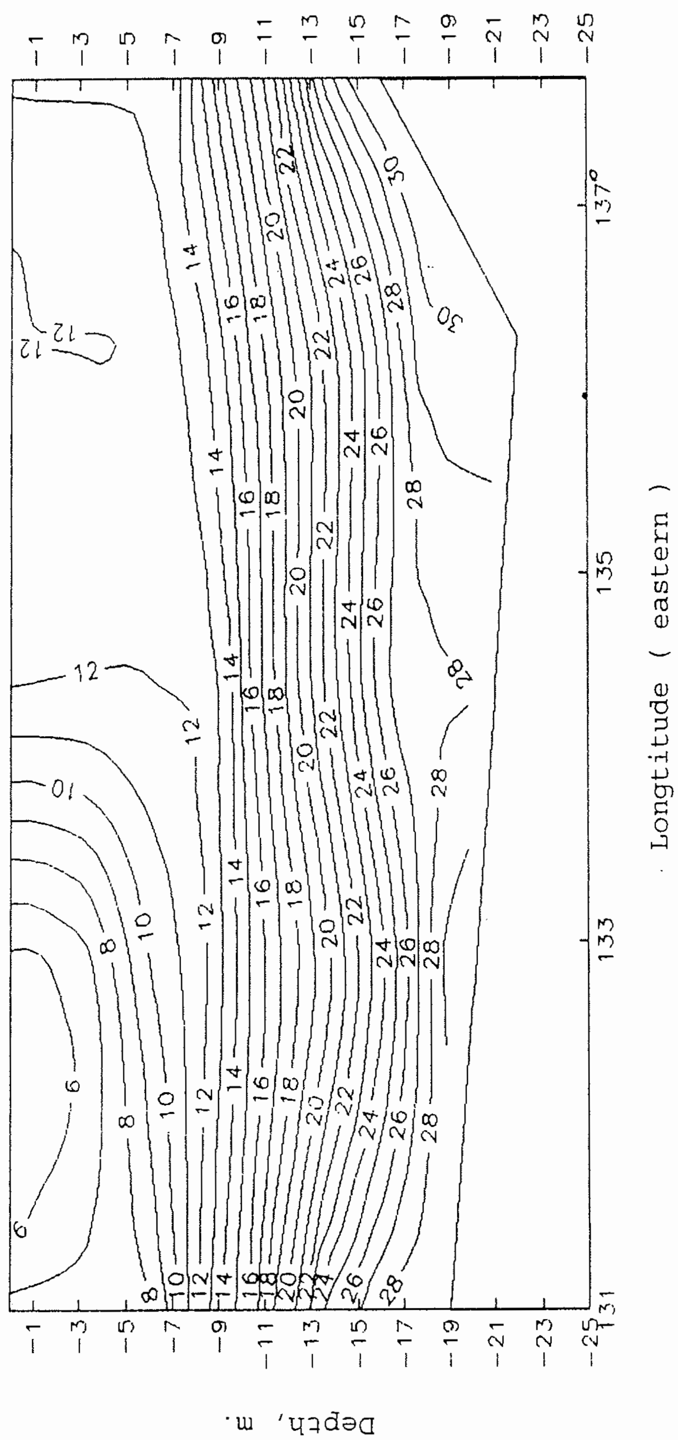


Fig. 46: Vertical salinity section (‰) along 72°30′ N.L. (29.-31.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

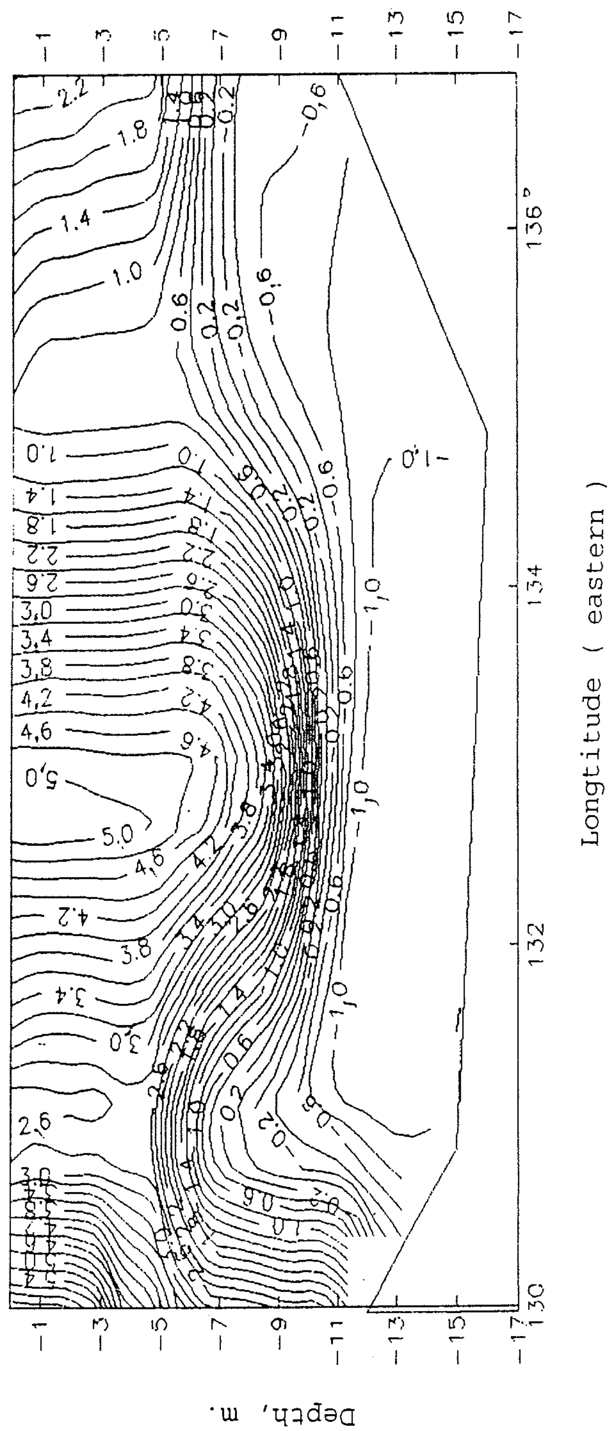


Fig. 47: Vertical temperature section (°C) along 72° N.L. (24.-28.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

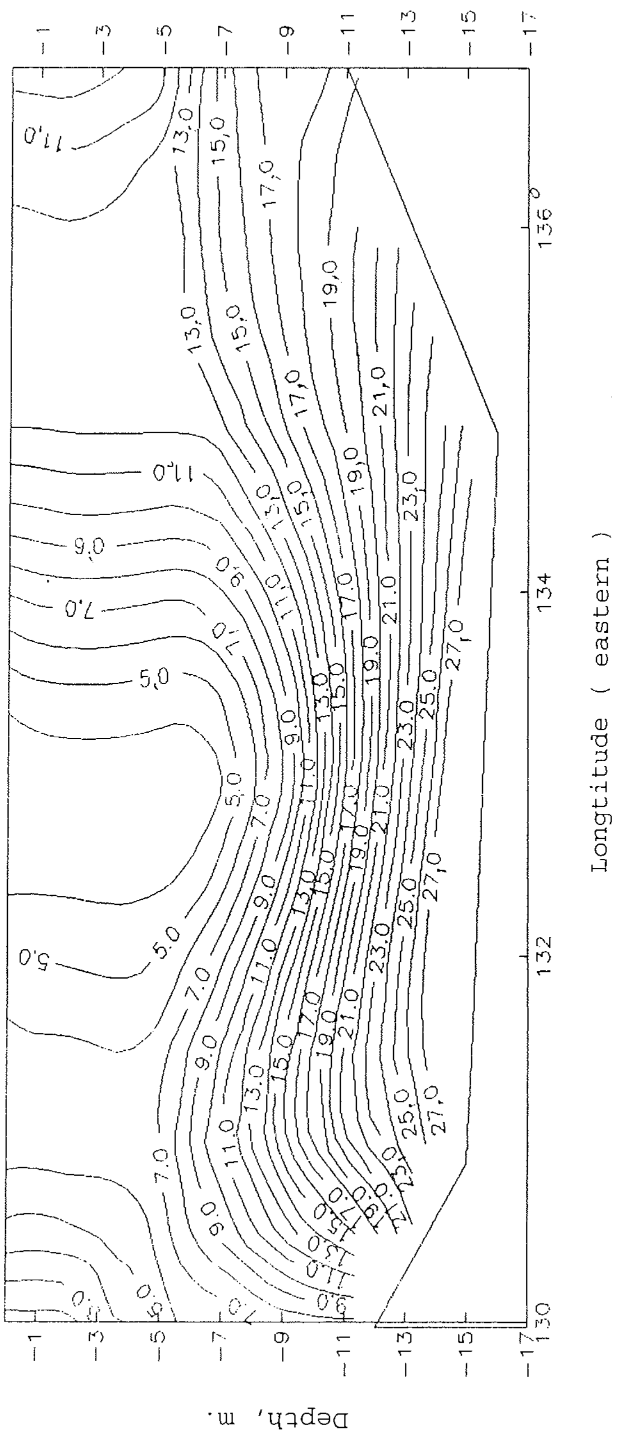


Fig. 48: Vertical salinity section (‰) along 72° N.L. (24.-28.08.93, TRANSDRIFT I expedition on board RV *Ivan Kireyev*)

4. HYDROCHEMICAL STUDIES

4.1 Hydrochemical Structure of the Laptev Sea

Pivovarov S.

It is well known that the Laptev Sea has a complex and variable hydrochemical structure. The biogenic elements (particularly silicates) and dissolved oxygen appear to be reliable indicators of water masses. In addition, these parameters are necessary to investigate the hydrobiological processes.

The goal of the hydrochemical program is to investigate:

- the distribution of water masses, which have formed under different conditions;
- the influence of river run-off on the formation of hydrochemical sea structure;
- the relationship between the hydrochemical and hydrobiological parameters of sea water.

Work Program

During the survey dissolved oxygen and silicates were determined at standard levels at each oceanographic station of the sections. In the polygon near the ice edge, dissolved oxygen and phosphates were determined at the levels of 0, 5 and 10 m. Here the distance between the stations was 2 miles. Phosphate was also determined at those stations where hydrobiological studies were carried out.

Biogenic elements and dissolved oxygen were determined in accordance with the Russian "Handbook on the methods for the chemical analysis of sea water".

Preliminary Results

During the oceanographic survey (08.08-14.09.1993) the following investigations were carried out:

- 488 determinations of dissolved oxygen at 93 stations;
- 448 determinations of silicates at 84 stations;
- 160 determinations of phosphates at 39 stations.

Brief conclusions and comments

1. River run-off plays an important part in the formation of the hydrochemical structure of the Laptev Sea. In the eastern part of the sea, the water layer which was exposed to the influence of river run-off was 5-10 m thick and extended to 76° N. According to the data of many years, however, this is not the maximal extension of the influence of river water. The isoline of a Si

content of 250 µg/l is assumed to be the boundary of the influence of river water. The maximal concentration of silicates was observed near the Lena river mouth (Si 1430 µg/l) (Fig. 49).

2. Bottom depressions in the south-eastern sea are filled with water with a low concentration of dissolved oxygen. This is related to the twelve-month influence of river run-off and to the presence of large vertical gradients of density. These stagnant waters, that flow northward and occupy positions in the water column according to termohaline circulation, can significantly disturb hydrochemical structure.

3. Three layers of water masses were observed at the stations and shallow troughs in the south-western part of the sea. One water layer, that formed during the last winter, is determined between the 5 and the 25 m level. It has a high salinity and large supplies of dissolved oxygen, a low temperature and a minimal silicate concentration. The overlying layer of fresher sea water is supersaturated by dissolved oxygen up to 110 %. The deepest layer between the 25 m level and the bottom level (about 40 m) had the largest salinity which was observed in the Laptev Sea during the survey (34.40-34.55 ‰) and the lowest temperature. High oxygen concentration (94-96 %) indicates a good ventilation of this layer and its recent formation (Fig. 50).

4. After all data that were collected during the expedition have been varified, they will be used to investigate the interannual variability of hydrochemical parameters and of water mass structure in the Laptev Sea.

4.2 Studies of Water Pollution

Chigak M.

The studies of the spatial and temporal distribution of the main groups of pollutants in the Laptev Sea waters are a part of the governmental program for the monitoring of pollutants in the environment of the Arctic Seas (AMAP). This program has been developed by a group of experts of the Arctic States. Its main aim is to control the pollution in the Arctic region which is due to human influence.

During the TRANSDRIFT I expedition the following investigations that were part of this program were carried out:

Sea water samples were taken:

- in the surface layer to determine concentrations of heavy metals (Cu, Zn, Hg, Cd, Co, Mn, Pb, Fe), petroleum hydrocarbons, polyaromatic hydrocarbons (PAH), organochlorines, total phenols, anionactive detergents;
- at the near bottom level to determine heavy metals (HM), petroleum hydrocarbons (PH), organochlorine compounds (OCC), phenols;
- from the sea floor to determine main pollutant groups.

The sampling was made at stations which were confirmed by the Regional Center "Monitoring of the Arctic" (St. Petersburg). The aim of the pollutant monitoring of this region is as follows:

- determination of the natural background level of pollutants;
- detection of the pollutant input sources;

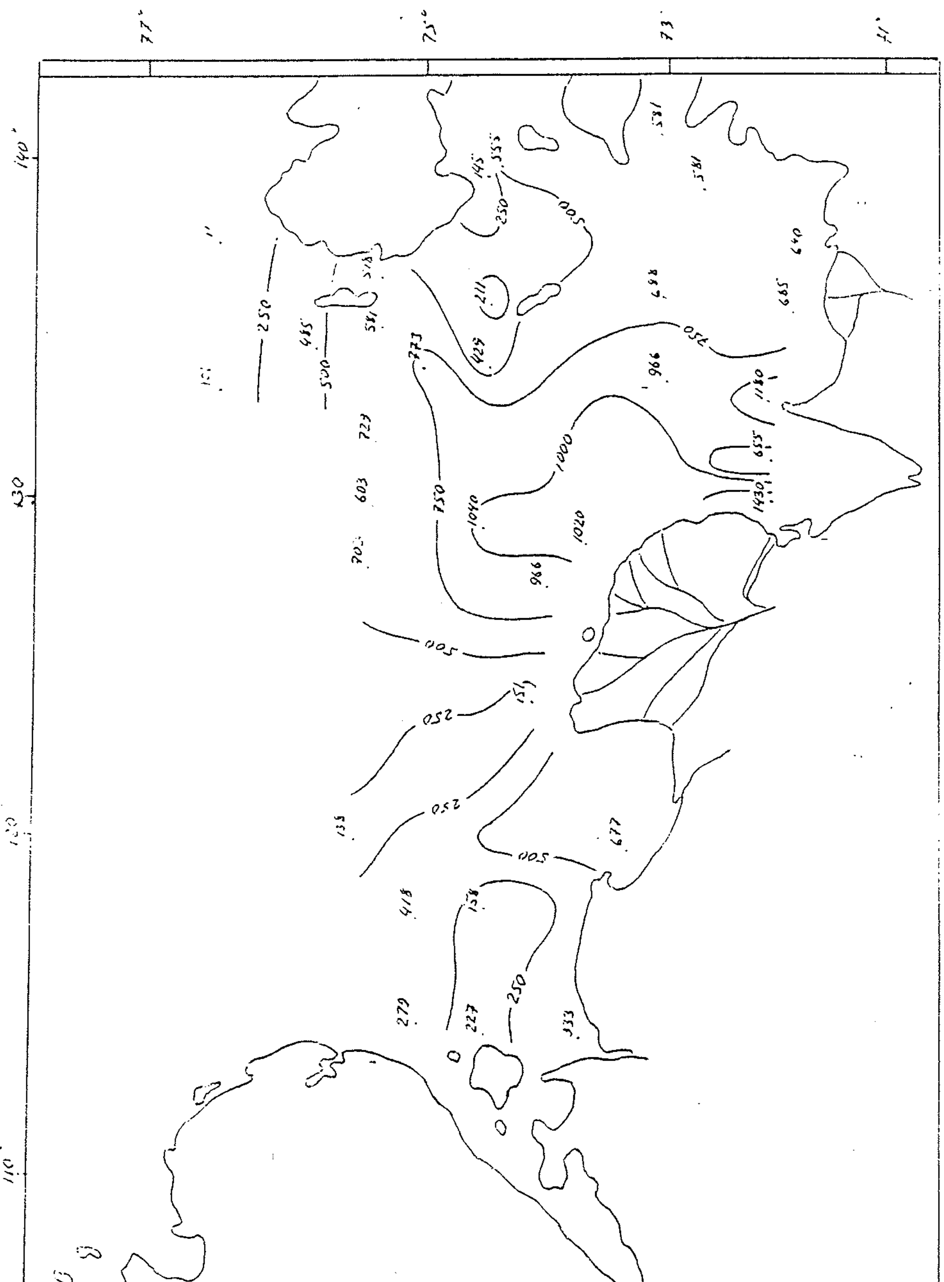


Fig. 49: Map of Si distribution (mcg./l., surface layer)10.08.-10.09. 1993

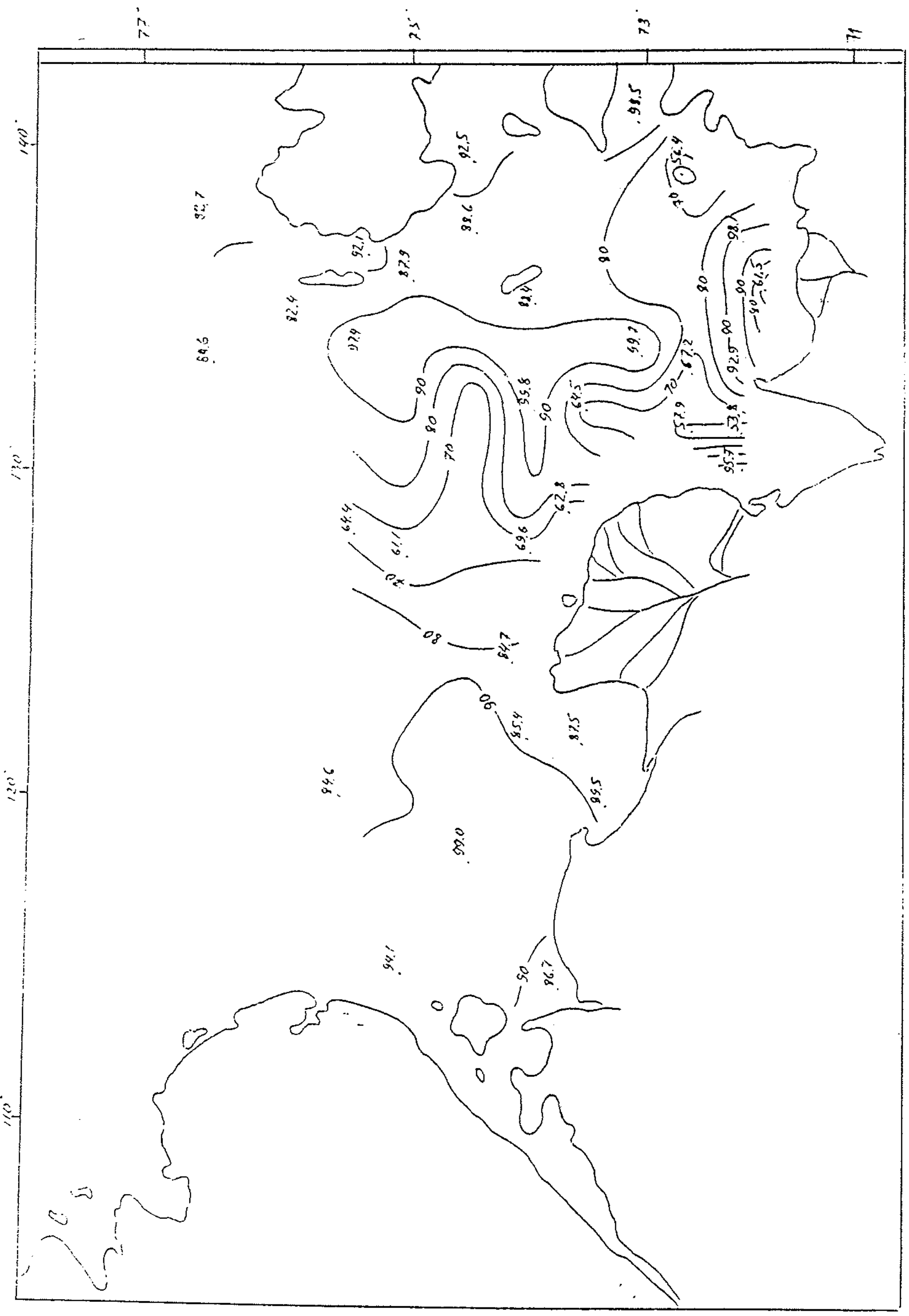


Fig. 50: Map of dissolved oxygen distribution (%, bottom layer)10.08.-10.09. 1993

- detection of the zones with enhanced concentrations of pollutants and determination of the influence of river run-off on their distribution;
- analysis of spatial and temporal variability of the zones with enhanced concentration of pollutants.

The concentration of the extraction of sea water samples for the determination of HM, PH, OCC, PAH, and phenols was carried out aboard the ship. The determination of concentrations of anionactive detergents was carried out directly aboard the ship according to the photocolourmetric method. The determination of concentrations of HM, PH, OCC, PAH and phenols will be made at the base laboratory of the Regional Center "Monitoring of the Arctic":

- OCC are determined according to the gas chromatography method;
- HM are determined by means of emission spectroscopy;
- PH, PAH, phenols are determined according to the spectroscopic method.

During the expedition the following number of samples was taken and tested:

- 46 samples for HM;
- 52 samples for PH;
- 52 samples for OCC;
- 39 samples for PAH;
- 40 samples for total phenol;
- 31 samples for anioactive detergents;
- 35 samples of bottom deposits.

4.3 Radiochemical Observations

Bovkun L.

Since radioecological studies of the Laptev Sea area had not been carried out before, the works which were executed within the scope of the TRANSDRIFT I program should be considered as reconnaissance ones.

According to this, the aims of the expedition were as follows:

1. to determine the level of radioactive pollution of water and bottom sediments of the Laptev Sea by radionuclides of artificial origin;
2. to determine the possibility to use radionuclides (for example Cs-134) for tracer oceanography.

Observation Methods

Water sampling was carried out with the pump "Malysh". The maximal capacity of this pump is about 800 l/h. At first all water samples were filtered in oder to determine the concentrations of suspended particles that were larger than 1 µm. Then the samples were passed through a fiber sorbent, which was impregnated with Cu Fe (CN) (sorbent for cesium). Owing to the expected low cesium concentrations, the sample volume was not less than 1600 l. If required, 10 l of filtrate was sampled for strontium analysis. The procession of the samples aboard the ship consisted in the precipitation of Sr, Ca, Mg carbonates with Na CO. One litre of filtrate was sampled for a tritium analysis. Water sampling was only made at hydrological stations. As a rule, the samples were taken in the surface layer (1 m level) and, if time allowed, in the near bottom or intermediate layer, which was dependent on the obtained salinity and temperature profile.

Preliminary Results

In total were taken:

- 29 samples for Cs analysis,
- 20 samples for Sr analysis,
- 21 samples for 3H analysis.

For Cs analysis, bottom samples were taken with a box core up to a depth of 10 cm below sea floor at most of the 35 geological stations (Tab. A2). It is too early to speak about the specific scientific prospects before the data which was obtained during the expedition have been analysed. It is evident that any data is of great value, so, for instance, data on:

- the distribution of radionuclides according to depth northward of 75° N (both in terms of radioecology and oceanography);
- the dynamics of radioactive pollution in water and bottom deposits;
- the accumulation of radionuclides (Cs, Sr) in hydrobionts and the migration of these isotopes in trophic chains.

The time for water sampling can considerably be reduced if samples are collected at several levels at the same time.

5. BIOLOGICAL STUDIES

5.1 Hydrobiological Investigations in the Laptev Sea

Petrjaschev, V.

During the last 125 years 23 expeditions have been carried out in the Laptev Sea. In the course of these expeditions only 360 biological stations have been occupied so far. Quantitative samplings have been made at 160 stations in 5 small regions, mainly near the shore in the south-eastern and eastern sea. That is why at present we cannot even come to a complete faunistic assessment of the biota of this Arctic region. The studies of the ecosystems and their distribution have only been initiated.

The scientific goals of the expedition were as follows:

1. to specify macrobenthos and plankton species in the Laptev Sea,
2. to clarify the distribution of biocenoses at the shelf of this sea,
3. to determine quantitative characteristics of bottom biocenoses - population density and organism biomass,
4. to establish the distribution dependence of bottom biocenoses on hydrological characteristics and soils,
5. to determine the distribution of the species of the estuary-arctic complex in the Laptev Sea.

Work program and methods

Phytoplankton was sampled with a phytoplankton net (30 cm section). Zooplankton sampling was carried out with a Nansen net (50 cm section), and catches were made with an epifauna plankton net (60*30 cm). Further flora and fauna studies of phyto- and zooplankton will be made in the laboratories of the Zoological and Bothanical Institutes of the RAS.

Microbenthos was collected with a Van Veen and a Petersen grab and with a small Sigsby trawl. After the samples had been sorted, the number of the specimens of each taxon was determined. Then the specimens were weighed with a ship balance. Based on these data, the population density (number of specimens) and the biomass were calculated both for some taxons and the entire macrobenthos. The ecosystems of the stations with similar dominant and subdominant species were combined into one biocenosis.

Preliminary results

Thirty-nine biological stations were occupied during the cruise of the *Ivan Kireyev* (Fig. 4). The benthos samples were taken at 38 stations: 10 samples at 4 stations with the Van Vin's ground sampler, 98 samples at 33 stations with the Petersen ground sampler, 36 samples at 36 stations with the Sigsby trawl. Plankton samples were taken at 32 stations: 22 samples at 22 stations with the epifauna plankton net, 39 samples of zooplankton at 19 stations and 16 phytoplankton samples at 16 stations, in each case with the Nansen net.

On the basis of the obtained results, the population densities and biomasses of macrobenthos organisms were calculated, and the dominant taxons, mainly species, were determined.

The smallest biomasses of the investigated area were noted in coastal waters between 9 and 15 m water depths (B=10.782-50.902 g/m^2) and northward of the Yana Bay (st.9, 9 m depth, B=12.127 g/m^2). Exceptions were found only in the Anabar Bay (st.2, 9 m depth, B=86.754 g/m^2) and in the eastern part of the Olenek Bay (st.24, 12 m depth, B=168.238 g/m^2). The biomass metered at the last station was not only the highest one in the coastal region of the Laptev Sea, but belonged to the highest biomasses observed during the whole cruise. The largest biomasses (B=147.606-370.775 g/m^2) were found in the central and western sea, in the area of 74° 30' N - 75° 00' N, at a depth of 25-44 m. The corresponding samples were taken in coastal regions and regions influenced by an intensive river run-off. The macrobenthos biomass at the stations with an approximately equal water depth was larger than that at stations located closer to the river mouths. This is probably due to the outflow of biogenes by the rivers. However, in the vicinity of about 75° N the picture was quite different. It is possible that the ecosystems at more northern stations are less exposed to the influence of the river desalination than those at more southern stations. Thus the conditions at the northern stations are more stable.

The distributions of macrobenthos populations in the investigated area of the Laptev Sea approximately coincided with those of biomass. Two regions, however, were an exception. The first region was confined to the stations 48 and 50 (23-28 m water depth). Here a relatively low density of populations (185.84-402.54 specimens/m^2) was observed whereas the biomasses were relatively average ones (96.558-93.873 g/m^2). This is probably due to the dominance of large *Urasterias lincki* in the ecosystems. The second region included the most north-eastern stations. In this area with low and average biomass values (34.751-150.333 g/m^2), a very high population density (1202.61-2300.69 specimens/m^2) was noted. This can probably be attributed to the fact that the samplings were made at these stations at the end of the expedition, i. e. at the end of the first and the beginning of the second decade of September. During this time the bottom precipitation of plankton larvae, particularly of bivalve mollusks, was taking place in this region since a large number of juvenile specimens of the latter was found in the samples of these stations.

According to the expedition data, the main characteristics of the investigated ecosystems are the density of populations and of macrobenthos biomass in dependence on:

1. water depth,
2. the soils depending on their granulometric composition,
3. near bottom temperatures,
4. water salinity and water density,
5. the oxygen content of the water, and
6. soil surface temperatures.

Preliminary results have shown that the macrobenthos biomass distribution in the Laptev Sea depends on near bottom water salinity and density. Minimal biomasses were observed at a water salinity between 7.72 and 8.63 ‰ and a water density between 1.00616 and 1.00688 g/cm^3 (B=10.782-40.250 g/m^2) as well as at a salinity between 29.91 and 29.99 ‰ and a density between 1.024 and 1.02404 g/cm^3 (B=12.127-18.446 g/m^2). With regard to salinity, the first minimal value coincides with the boundary between fresh water and brackish fauna, which according to V.V. Khlebovich is at 5-8 ‰. The first maximal value of the macrobenthos biomass was found at a water salinity of 14.04 ‰ and a density of 1.01119 g/cm^3 (B=168.238 g/m^2), the second one at a water salinity between 33.04 and 34.72 ‰ and a density between 1.02658 and 1.02765 g/cm^3 (B=57.462-323.420 g/m^2) (Fig. 51 and 52).

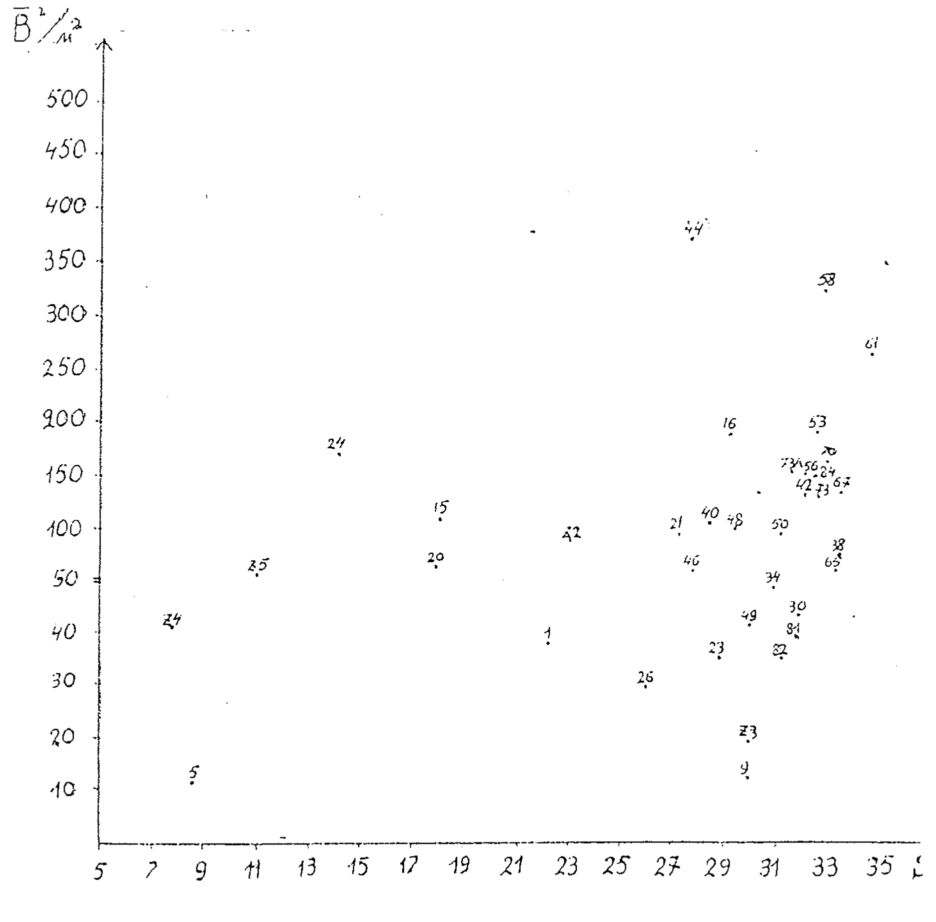


Fig. 51: Distribution of biomasses (B) versus water salinity of the bottom layers (‰) in Laptev Sea

In dependence on the distribution of echinodermata and species indicators of estuary-arctic waters, two regions were identified in which typical estuary-arctic species dominate: one in the southern and one in the central Laptev Sea. In addition, a transitional region between them was determined (Fig. 53). Here both expedition data and published data had been taken into account. Furthermore, it was found out that the boundary between the estuary-arctic

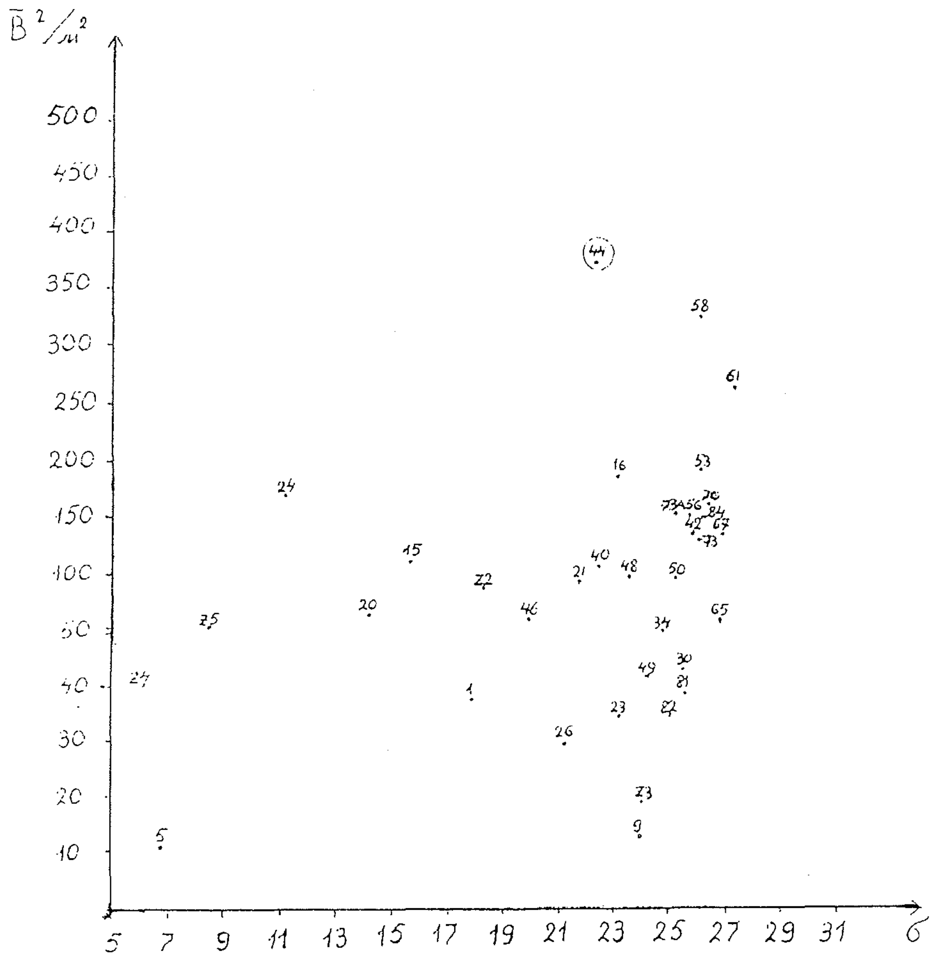


Fig. 52: Distribution of biomasses (B) versus densitiy of the bottom layers.

and transitional regions coincided with the second minimal value of biomass distribution with regard to near bottom water salinity (30 ‰) and density (1.024 g/cm^3).

According to preliminary data, 17 macrobenthos biocenoses were observed in the investigated area. For each of them the number of specimens and the biomass was calculated.

Conclusions

The TRANSDRIFT I expedition has been the first large comprehensive expedition in the Laptev Sea within the last decades. The joint work of scientists of different fields and the information exchange between them allow us to plan new experiments as well as to adjust experiments and studies that have been

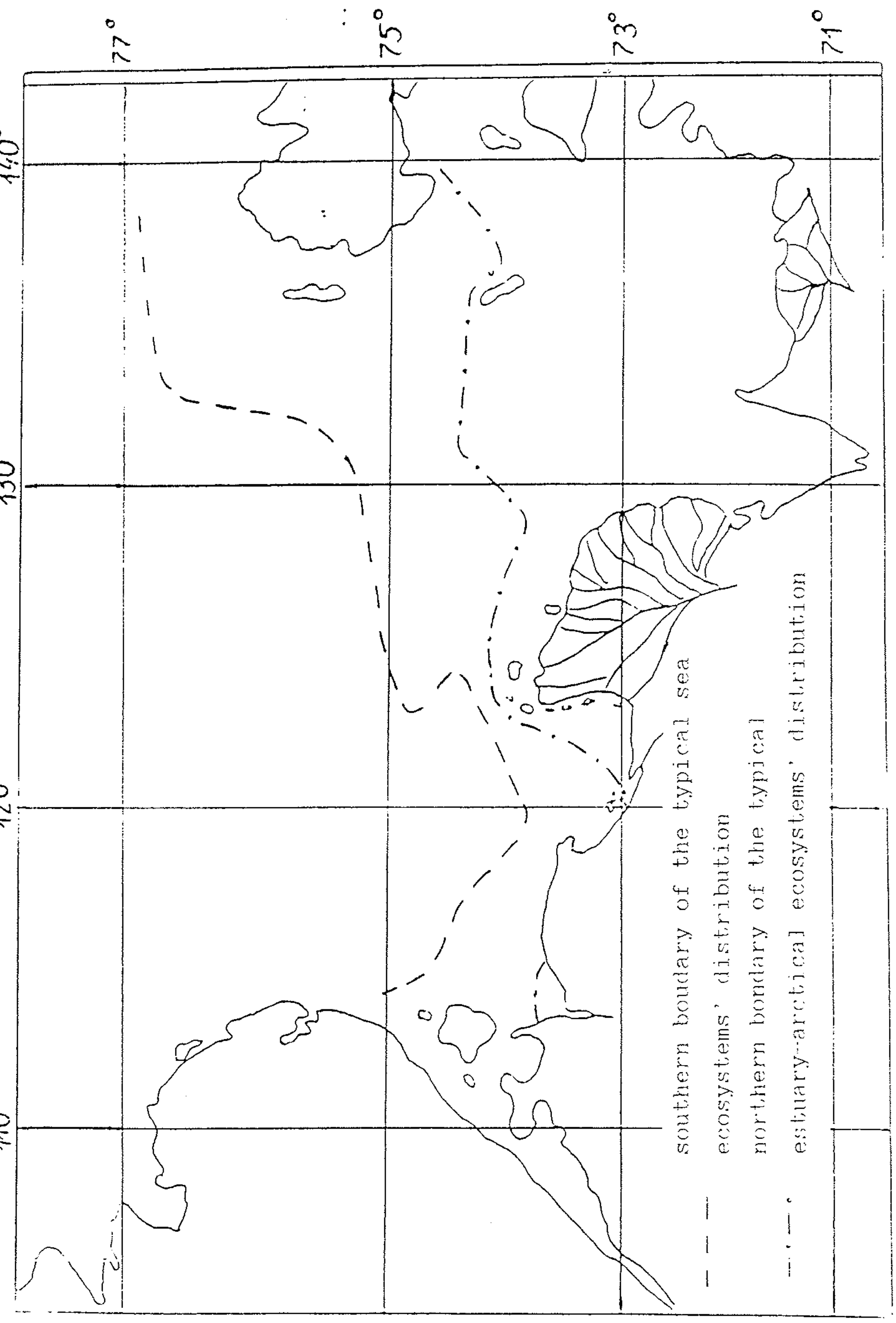


Fig. 53: Distribution of estuary-arctical macrobentos communities in Laptev Sea August-September 1993

planned before directly aboard the ship, which enhances significantly the quality of the work. In the course of the biological investigations, such a cooperation became most apparent during the determination of the effect of abiotic environmental factors on ecosystems.

As a result of this expedition, it has been possible for the first time to obtain quantitative data on biota in many regions of the Laptev Sea, first of all in its central and western parts.

It is obvious that the data of this expedition have to be considered as preliminary. The results should be specified during the next expeditions. The largest attention should be paid to the western Laptev Sea, which is most difficult of access. In order to clear out the distribution of coastal ecosystems and their characteristics, it is also necessary to carry out biological works directly near the coast, at least at 3-4 sites both in the western and eastern part of the sea. Possibly such works will be of interest to scientists of other branches of science. In order to obtain more detailed results, the studies of the next expeditions probably cannot cover the entire Laptev Sea area, but only separate parts of it. During the next expeditions, it will be desirable to set up a database on the accumulation of radioactive strontium and cesium isotopes in the hydrobionts of the Laptev Sea and on the migration of radionuclides with regard to trophic chains and networks.

5.2 Ecological Studies in the Laptev Sea

Knickmeier, K. and Schmid, M.

The biological investigations which were made during this cruise are part of the joint German-Russian project "German-Russian investigations of the ecology of the Eurasian Arctic Shelf Seas", which is funded by the German Ministry for Research and Technology (BMFT). The main aim of the project is to study interactions between the sympagic fauna, the pelagic zone and the benthos and to estimate the influence of the seasonal pulsed fluvial input of large amounts of freshwater and terrestrial sediment loads on organisms.

On the expedition TRANSDRIFT I we wanted to investigate the summer conditions of the zooplankton and benthos communities. A first quantitative analysis of the structure and the distribution of the communities can serve as a basis for further autoecological studies on dominant species. The species compositions and the community analysis of the fauna of the Laptev Sea (phyto- and zooplankton, zoobenthos) will be part of a large biogeographical database. This database will supply indicator species, which will help to understand the consequences of longterm and seasonal environmental changes.

The working-hypotheses of this expedition were as follows:

- The fauna is dominated by arctic-endemic species. The importance of boreal species is lower than in other Sibirian shelf areas.
- Euryhaline brackish and freshwater species are characteristic for the fauna of the shallower part of the Laptev Sea.
- The density of echinoderms is lower than in other polar regions, where they are by far the most dominant species group.
- The diversity of the community is lower than in other polar regions (e. g. in

East-Greenland).

- The distribution of the communities is regulated by the sea ice cover and the salinity gradient, which is due to freshwater inflow.

Work program and methods

Biological sampling was carried out on several transects from the near coast shallow region to the continental slopes.

Samples that were taken with a Niskin bottle (10 litres) in selected water depths provided the data to draw up vertical profiles of chlorophyll. Thus we were enabled to estimate phytoplankton biomasses and to relate biological and hydrographical measurements. Water samples (100 to 250 ml) taken from the same Niskin bottles were used for the quantitative analysis of the phytoplankton populations. The analysis was carried out according to the "Uthermöhl" method. Additional phytoplankton samples were taken with a Nansen phytoplankton net (20µm) to determine the species compositions.

Zooplankton was sampled with a Bongo-net (2 nets, each net 335 µm) in order to estimate the biomass and to integrate the spiecies distribution over the whole water column. A Multi-net (5 nets, each net 300 µm) was used for stratified sampling in selected water depths.

Zoobenthos samples were taken with a Reineck-box-corer and a small dredge (1*0,5 m). The box corer samples were sieved from 0 to 2 cm with a mesh size of 0.3 mm and down to 5 cm with a mesh size of 1 mm. The dredge catch was usually sieved as a whole, only in some cases subsamples were taken. The retrieved animals were preserved in 4 % formalin with 5 % Borax.

Underwater photos were taken to have pictures as well as small scale distribution patterns of the benthic communities in situ.

All samples will be investigated further at the Institute for Polar Ecology. Here the species and their abundance will be determined, and the biomass of each taxon will be estimated. Chlorophyll will be analysed according to the UNESCO method (1981).

Some zooplankton samples and subsamples of the dredge catches were frozen at -80° C for the analysis of radioisotopes (N15 and C13). The aim of this analysis will be to clarify the role of the organisms in the trophic structure of the Laptev Sea community. In addition, the gut content and the lipid content of some organisms will be analysed to assess the physiological condition and the nutritional history of the animals. The radioisotope samples will be investigated at the Institute for Nuclear Physics at the University of Kiel.

Preliminary results

During the expedition the focus of biological sampling was on four major transects with 34 stations (Fig. 4). These stations show as well a clear salinity gradient, that is strongly influenced by the Lena input, as a clear east-west gradient, which is due to the influence of the Atlantic and Pacific Ocean respectively.

Phytoplankton samples were taken at 34 stations. Zooplankton samples were taken at 29 stations with a Bongo net and at 10 stations with a Multi-net. Benthos samples were taken at 28 stations with a dredge and at 25 stations with a box corer. In total about 600 underwater photos were taken at 28 stations

About 140 samples of chlorophyll from 35 stations will be analysed in the laboratories of the Institute for Polar Ecology. In a pilot study for the radioisotopes, 40 benthic samples of seven stations will be analysed at the Institute for Nuclear Physics of the University of Kiel.

Scientific perspectives

The successful interdisciplinary work of all scientists on board the *Ivan Kireyev* will allow us to interpret the gained biological data. The data sets of former Russian expeditions to the Laptev Sea will enable us to detect long-term changes in the different communities. Furthermore, they can be related to environmental changes of the region as well as to the entire Arctic Ocean.

While the scientists aboard the *Ivan Kireyev* were taking biological data in the shallow part of the Laptev Sea, two biologists of our project, who were taking part in the ARK IX/4 expedition on board the RV *Polarstern*, were collecting similar data in the deeper part of the sea. The combined data will allow a good evaluation of the summer situation and the biological community in the Laptev Sea. Two further expeditions to the Laptev Sea, which are scheduled for autumn 1994 and spring 1995, can help to understand the adaptations of the organisms to the annual cycle of the strong freshwater inflow and the coupling between ice, icefauna, pelagial and benthal.

6. GEOLOGICAL INVESTIGATIONS

6.1 Geosystem Laptev Sea

Kassens, H.

Most recent investigations in the Arctic Ocean have stressed the importance of the broad Siberian shelves for shelf-to-basin sediment transport processes, in particular for the formation of 'dirty' sea ice. Above all, the Laptev Sea, which belongs to the world's largest and shallowest shelf areas, acts as a source area for high amounts of fine-grained sediments being transported to the deep Arctic Ocean (e.g. Wollenburg, 1993, Nürnberg et al., in press). Thus, the transport of sediments in the Laptev Sea is highly related to (i) specific ice formation processes, such as anchor ice or suspension freezing, as well as to (ii) hydrological and geomorphological phenomena, such as currents or transport of suspended particulate matter. As a result, even short-term climatic fluctuations will have a significant impact on the cross-shelf sediment transport. However, little is known in detail about the relationship between morphology, river run-off and discharge, erosion, sediment transport and sea ice formation in the Laptev Sea area (Holmes and Creager, 1972; Dethleff et al., 1993; Reimnitz et al., in press).

The depositional environment of the Laptev Sea is mainly controlled by the river run-off of the large Siberian river systems, such as the River Lena, which has a drainage basin of 2.43 * 10^6 km^2 and contains numerous industrial sites. With an average river discharge of 525 km^3/year, the Lena River is the second largest river discharging to the Arctic Ocean and the eighth largest of the world (Gordeyev and Sidorov, 1993). The Lena run-off accounts for more than 70 % of the overall inflow of riverine waters into the Laptev Sea. On its way through swampy lowlands, the river accumulates a high dissolved organic load on the one hand and loses the suspended sediment load on the other hand. The Lena River annual discharge of total organic carbon is 8.5 * 10^6 tons, which is about 30 % of the overall organic carbon transport to the Arctic Ocean. This is by far the highest discharge of all Arctic rivers.

The fresh water input also controls the formation and export of enormous amounts of ice. According to Russian data, about 910 km^3 of sea ice are produced for the Transpolar Drift in the Laptev Sea during the Arctic winter months (October - April). In wintertime in this area, a perennial polynya (a narrow zone of open water), which is maintained by strong offshore winds, borders the hundreds of kilometers wide and very smooth fast ice of the Laptev Sea (Dethleff et al., 1993). In the Laptev Sea polynya, rapidly forming ice is continuously advected offshore, which makes the Laptev Sea the only major ice factory for the Arctic Ocean and the Transpolar Drift. The Russians have known that for many years (Zakharov, 1966). Thus, the Laptev Sea might be a key region for investigations within the scope of Global Change.

The goals of geoscientific investigations during the TRANSDRIFT I expedition are:

- to study the role of river run-off for the sedimentary environment of the Laptev Sea, in particular the transport paths and the depositional center of river discharge,
- to investigate the Laptev Sea polynya and its effects on sedimentation,

- to identify source areas and transport paths of 'dirty' sea ice,
- to assess the relevance of specific sediment redistribution processes,
- to identify agents for the shelf to basin sediment transport in the Laptev Sea,
- to investigate the Late Quaternary variability of the Siberian river input into the Arctic Ocean.

Working Programme

In order to gain a wide-ranged view of the sedimentary environment of the Laptev Sea, extensive investigations of the water column and the sea floor were carried out by the geological working group on board the RV *Ivan Kireyev*. The working programme was conducted at a total of 47 stations in the ice-free shelf area, including those located at river mouths (Fig. 4 and Tab. A2).

The following investigations were carried out during the TRANSDRIFT I expedition on board the RV *Ivan Kireyev* (see also Tab. A2):

- Site survey and mapping of the horizontal and vertical distribution of the young sediment cover by means of continuous subbottom profiling (ATLAS-DESO 10, KRUPP ATLAS-Elektronik Germany) and Side Scan Sonar (HYDROSCAN).
- Water sampling for multielement and PCB analyses as well as for tracer oceanography.
- Deployment of three moorings W of Kotel'neyy Island in order to get a continous record (max. 1 year) of sea-floor temperature and conductivity.
- Sampling of near surface sediments at the Russian monitoring stations with a Van Veen grab.
- Sampling of undisturbed near surface sediments at the Russian monitoring stations with a REINECK box core (penetration weight 400 kg, 10*28*44 cm).
- Coring of undisturbed long sediment cores at selected key stations, such as the Lena Trough, with gravity cores. Two types were employed: (1) a gravity corer (ø 14 cm) with a penetration weight of 0.8 t and a core barrel segment of 3 to 5 m in length (HYDROWERKSTÄTTEN Kiel, Germany). (2) A higher priority was given to the 'kastencorer' (rectangular cross-section of 30*30 cm) with a penetration weight of 0.8 t and a corebox segment size of max. 575 cm (HYDROWERKSTÄTTEN Kiel, Germany). The great advantage of the 'kastencorer' is its minimal degree of sediment disturbance owing to a wall thickness of only 0.2 cm. The high quality of the obtained sediment cores was also verified by x-ray radiographs.

The coring statistics of the TRANSDRIFT I expedition is summerized in Tab. 1. In general, the coring devices used have shown a low core recovery. Even changes of the penetration weight or the winch velocity, which are supposed to increase the core recovery, were not successfull. We assume that the limited core recovery during this expedition is due to (i) sand and/or silt layers occurring at the base of some core catchers (Tab. A3) as well as to (ii) the base of permafrost, which has already been indicated by the low sea-floor temperatures measured (down to -2.3°C). This was confirmed by investigations in the Lena Trough, where we penetrated the permafrost boundary at a depth of 12 cm below the sea floor.

Tab. 1: Sediment coring during the TRANSDIFT I expedition

Sediment corer	Attempts all / succ.	Recovery (m)
Van Veen grab	77/75	16
Box core	146 / 144	41.78
Gravity core	3 / 2	3.16
Kasten core	25 / 17	15.00

A detailled description of our comprehensive geological working programme and the preliminary results of the TRANSDRIFT I expedition will be given on the following pages. The geologcal working and sampling programme is summerized in Table A2 and A5.

6.2 Dynamic Geological Shelf Processes - Implications From Side-Scan-Sonar Observations

Antonow, M. and Lindemann, F.

Nearly perennially ice-covered shelves are believed to be morphologically monotonous regions with a restricted morphodynamic activity. At first sight it seems that during wintertime vertical as well as lateral processes of particle transport and water movement take place on a very small scale only. Side-Scan-Sonar investigations allow an insight into the small scale topography and reveal a visual impression of the underwater landscape, which, however, appears to be affected by ice erosion to a high degree.

Since sediment distribution as well as benthic life are closely related to topographic features, Side-Scan-Sonar surveys provide an important data set for further interpretations of the ecological and sedimentary environment.

During the cruise Side-Scan-Sonar surveys were carried out over 13 transects (Tab. 2). For the observations a 'Hydroscan' equipment by Klein Associates, Inc., New Hampshire, U.S.A., was used. The Klein three channel model 530 combines a 100 kHz tow fish (model 422 S) with a 3.5 kHz subbottom profiler (model 532 S).

The sonar unit (1° horizontal beam) was usually trawled between 5 and 10 m over ground. The trawling velocity of the tow fish was about 4 to 5 knots over ground (a lower speed was not favorable for the ship engine over long distances). More than 100 nautical miles were investigated.

Best results were yielded by surveys at water depths between 10 and 35 m. Shallower areas could not be investigated because of the draught of the RV *Ivan Kireyev*. In addition, the investigations of deeper valleys were restricted by the cable length of the tow fish.

The Side-Scan-Sonar survey resolved the morphologic details affected by

Tab. 2: Side-Scan-Sonar surveys carried out during the TRANSDRIFT I expedition

Profile-code		Latitude	Longitude	Location	Remarks; Profile Distance
IK 93Sc-1	start	73°46.4 N	114°06.6 E	north of Anabar river	common medium size plough marks; 5.7 nautical miles (nm)
	end	73°51.9 N	114°12.7 E		
IK 93Sc-2	start	74°20.0 N	123°30.6 E	north of Lena delta	rare scattered, fine plough marks; 3.9 nm
	end	74°17.5 N	123°46.1 E		
IK 93Sc-3	start	74°11.2 N	124°03.7 E	north of Lena delta	rare plough marks; 4.9 nm
	end	74°15.6 N	124°15.0 E		
IK 93Sc-4	start	74°28.3 N	137°02.6 E	southwest of Kotel'nyy Island	deep, presumably old plough marks, station 48; 1.8 nm
	end	74°30.5 N	137°01.4 E		
IK 93Sc-5	start	74°28.5 N	139°44.8 E	Sannikov Channel south of Kotel'nyy Island	very rare diffuse plough marks; 3.7 nm
	end	74°25.3 N	139°52.3 E		
IK 93Sc-6	start	74°24.1 N	139°54.3 E	Sannikov Channel NW of Maly Lyakhovski	very rare diffuse plough marks, 3.6 nm
	end	74°21.3 N	140°02.0 E		
IK 93Sc-7	start	75°50.4 N	134°32.9 E	Yana valley west of Bel'kovskiy Island	scattered very deep marks in the SW, big, broad marks in the NE, plough marks in the NE more common; 12.5 nm
	end	75°55.9 N	135°17.8 E		
IK 93Sc-8	start	76°06.8 N	136°23.4 E	northern Zarya Strait NW of Kotel'nyy Island	common presumably old, medium size marks, small zones with presumably young, narrow, parallel marks with gentle relief; 12.8 nm
	end	75°55.1 N	136°41.3 E		
IK 93Sc-9	start	75°56.7 N	136°44.4 E	northern Zarya Strait NW of Kotel'nyy Island	comparable structures to IK 93Sc-8; 5.9 nm
	end	76°02.4 N	136°35.6 E		
IK 93Sc-10	start	75°25.1 N	130°32.1 E	western Stolbovoy Shoal	presumably old marks down to a water depth of 39 m; 10.9 nm
	end	75°24.4 N	131°17.8 E		
IK 93Sc-11	start	75°22.0 N	132°40.9	eastern Stolbovoy Shoal	rare medium sized, presumably old marks; 5.6 nm
	end	75°21.9 N	133°30.2 E		
IK 93Sc-12	start	76°06.8 N	136°53.9 E	north of Kotel'nyy Island	plough marks of different intensity, presumably young, fine, narrow plough marks (S) and presumably old, broader plough marks (W); 24.5 nm
	end	76°30.4 N	137°20.2 E		
IK 93Sc-13	start	77°00.5 N	137°20.9 E	north of Kotel'nyy Island	common presumably old, huge, diffuse plough marks; 11.2 nm
	end	76°49.6 N	137°17.9 E		

dynamic geologic processes on the Laptev Sea Shelf. Thereby, few parabolic bottom structures with sediment accumulation in lee position were recorded. These structures indicate bottom current activity. However, typical ripple marks, which are a result of a persistant bottom current regime, were absent. Thus, at least the investigated part of the inner Laptev Sea Shelf is likely to be a low energy area regarding hydrodynamics.

The most conspicuous topographic features are plough marks (gouges) generated by drifting ice. These marks are different in size, depth, age and spatial pattern. Four areas of different morphologic character were determined:

1. Areas with diffuse, large, by all appearances old plough marks.
2. Areas where plough marks are grouped into small zones with parallel, narrow marks showing a gentle relief.
3. Areas with scattered, by all appearances young plough marks. These gouges are deeper than most of the others.
4. Areas without any plough marks.

The area northwest of Kotel'nyy Island was selected to carry out a more intensive Side-Scan-Sonar survey because of the gentle oscillations of the polynya in this area during the last three to four years. This area shows much more gouges than all other investigated regions. Some of the furrows in this area are concentrated in small zones of plough marks, which are about 50 to 100 m in width (see No. 2 mentioned above). The rims of presumably young, scattered furrows are about 0.5 m in height (Fig. 54). The incision depth of some scattered, probably old marks is up to a few metres. They are, however, characterized by a diffuse shape and occur only in deeper water (Tab. 2, profile IK 93Sc-7).

The plough marks often showed 'crossings' (sometimes 's-shaped' structures), thus indicating an irregular ice movement (Fig. 54, 55, 56). Possibly many of the marks on shore are due to processes related to the position of the fast ice edge. Areas with fewer marks are documented on the western and eastern slope of Stolbovoy Shoal; profiles IK 93Sc-5 and -6 (south of Kotel'nyy Island, Tab. 2) show a monotonous bottom topography where gouges are very rare.

Further investigations of the orientation and distribution of plough marks will give an idea of the general drift pattern of the investigated shelf areas of the Laptev Sea.

6.3 Sediment Distribution in the Laptev Sea

Vogt, Chr., Lindemann, F. and Antonow, M.

Components, texture and fabric of marine sediments are the most characterisic features of the corresponding depositional environment. Component analyses yield a great deal of information on sediment origin, transport and deposition. Thus, as a scientific goal, the combination of these methods provides important data for the description and interpretation of sedimentary processes in the inner shelf region of the Laptev Sea.

All in all, sediment coring with spade box and gravity corers was carried out at 45 stations during this cruise (Fig. 4, Tab. 1, Tab. A2). The sediment cores

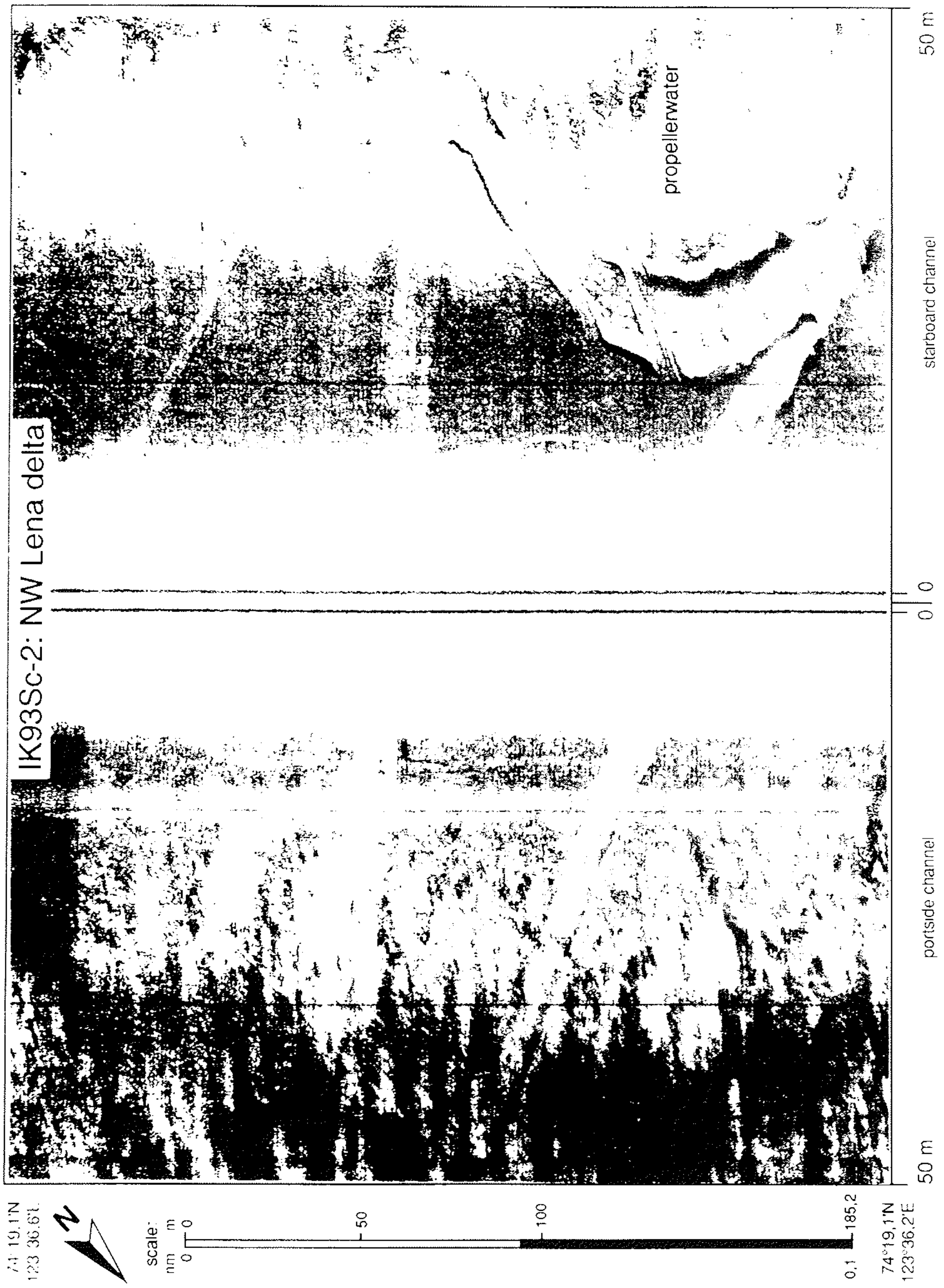


Fig. 54: IK93 Sc-2: Gouges northwest of Lena Delta in a water depth of 11 m (note irregular ice drift pattern)

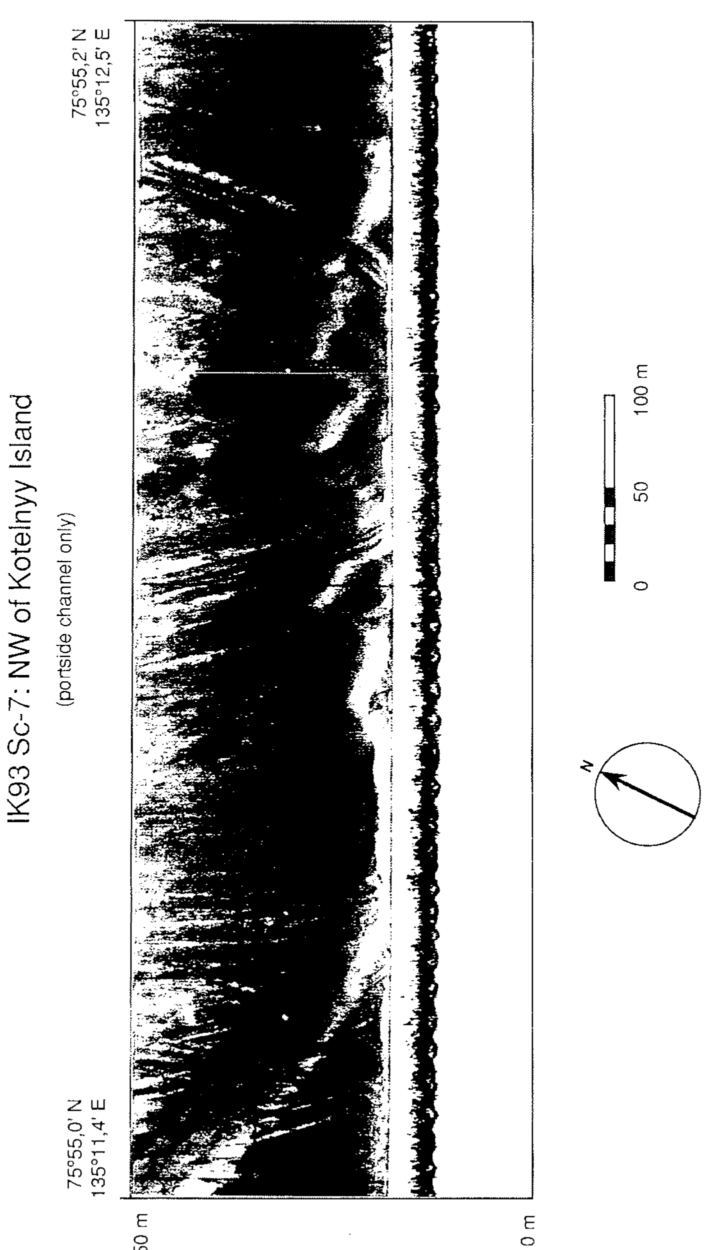


Fig. 55: IK93 Sc-7: Gouges west of northern Kotel'nyy Island in a water depth of 30 m. The figure shows a huge 's-shaped' plough mark and several marks crossing each other. Note that only the portside channel is documented in this figure.

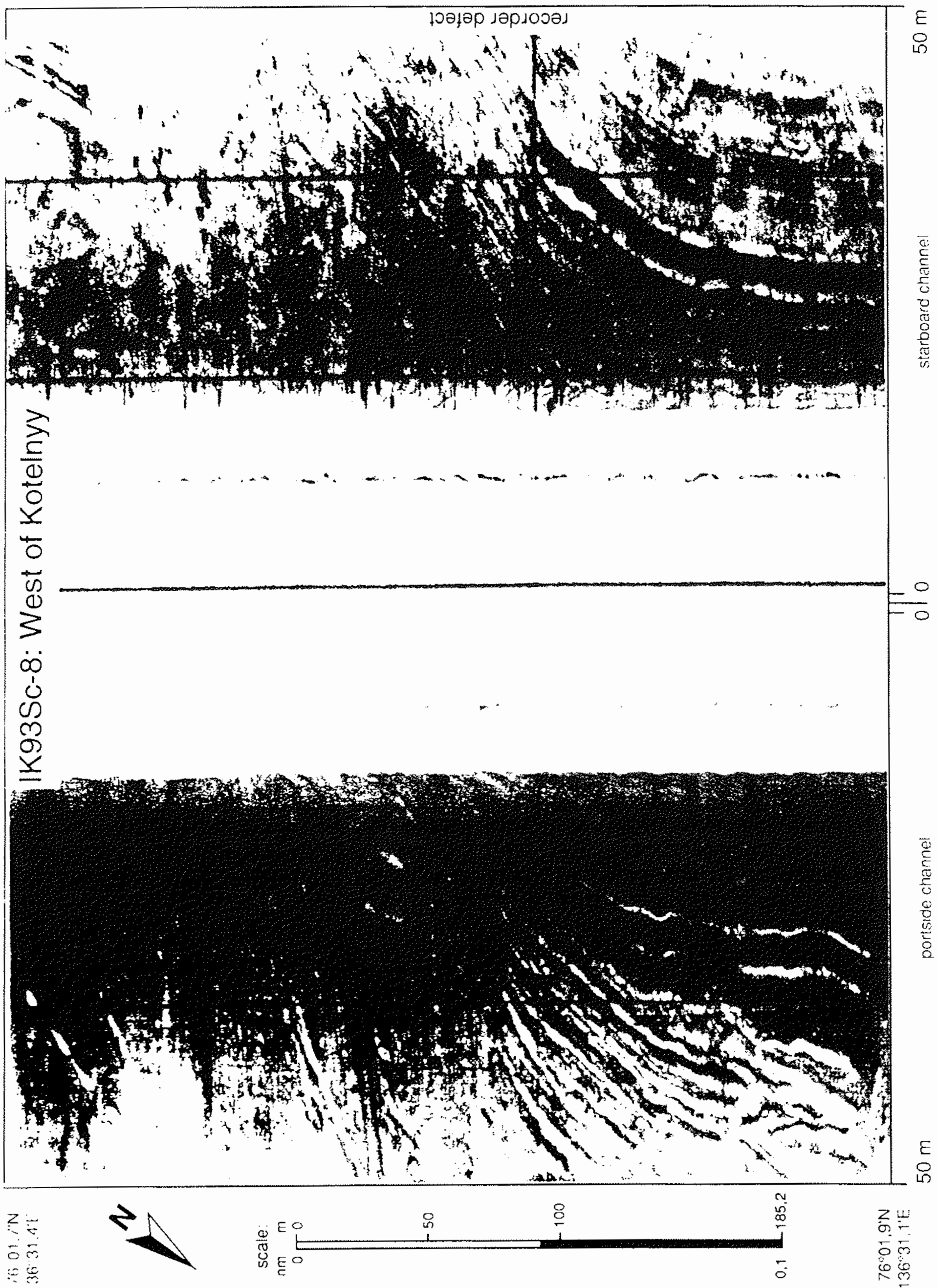


Fig. 56: IK93 Sc-8: Small scale topography of the shelf area of the Laptev Sea northwest of Kotel'nyy Island in a water depth of 21 m.

recovered during the expedition were photographed and described. Sediment colours were identified according to the 'Munsell Soil Color Charts' (Kollmagen Instruments Corp. Newburgh, U.S.A.). In addition, all surface sediments and selected sediment cores were subjected to smear slide analyses in order to estimate the sediment composition. The descriptions of all sediment cores are summarized in Tab. A3.

Near-surface sediments of the Laptev Sea are mainly fine-grained, such as clays, silts and muds. Sandy silts, silty sands and sands are common in the western Laptev Sea (IK93-26, -36, -38, -61), in shallow water depths, such as Stolbovoy and Vasilevskiy shoal (IK93-15, -40, -42, -44, -46, -49, -56), in front of river mouths (IK93-Z2, -24, -Z4, -Z5, -05, -23), and north of Kotel'nyy Island (IK93-82, -84, -K1 and 2). Sandy sediments were also found in box cores which were recovered along the profile at 75°30'N (IK93-65, -67, -68, -70) in the northern Laptev Sea.

While most of the cores show weak lithological changes, some near-shore sediment cores contain strong granulometric shifts from clay or silty clay to sandy silt and sand (e. g. IK9361-9 or IK9324-3 KG and -5 KL). This trend was also observed in sediment core IK93K2-1 north of Kotel'nyy Island. At the two near-shore stations off the Lena and Yana mouth (IK93Z4,-Z5), the opposite trend appears: sandy mud is overlain by clay. Sediment core IK93K1-1, which was taken between Bel'kovskiy and Kotel'nyy Islands, shows a comparable sediment record. In box core IK9323-5, various graded sequences and other textural features typical of river mouth areas are preserved.

In general, the sediment colour changes from the yellowish and grayish brown of a thin surface layer (1-2 cm) to olive and gray shades. The sediment cores IK9320-2, IK9336-3 and IK9346-5 contain only brown coloured sand. The sediment cores IK9301-5, IK9316-8, IK9323-5, IK9340-5, IK9344-10, IK9348-5, IK9356-1, IK9361-9, IK9370-6, IK9382-7, IK93Z5-4 and the long sediment core IK9309-6 show also black colours at the bottom of the core. The sediment cores IK93Z3-4 and IK93Z4-3 from the Olenek and Lena river mouths include also black sediment layers in their middle section. The silty clay of the sediment core IK9353-8 (34 cm penetration) reveals completely black colours. In addition, many cores show common black streaks and patches. The sediment core IK9358-2 and the long core IK9309-6 from the southeastern shelf region emitted H_2S at the bottom of the core. These observations may indicate suboxic to anoxic conditions a few centimetres below sea floor. In addition, well preserved wood could be recovered in the sediment cores IK 9316-9, IK9323-6, IK9338-5, IK9342-5, IK9373-7, IK93Z3-3. Plant debris covers the sediment surfaces of stations in the vicinity of IK9301-5, IK9313-7 and IK93Z5-4.

Benthic organisms are abundant everywhere. Thus, the sediments are well bioturbated. Living worms were found down to a core depth of about 15 cm; open burrows are common down to 90 cm depth below the sea floor. As a result, weak lamination was preserved only in few cores (e.g. IK9373-10 KL).

Thin manganese crusts covering worm tubes are common in many sediment cores. At the stations IK93-06, -34, -38, -49, -58, -61, -65, -70, -73 and -82, thicker crusts were abundant on bivalve shells and stones, which were collected at the sea-floor surface with a box corer and a dredge. Some massive manganese nodules were also found, especially in the eastern Laptev Sea. Dropstones from the box cores and dredges of stations IK93-48, -49, -56, -58, -61, -73, -82 and -K1 indicate ice transport in these regions. The sediment cores IK9384-1 and IK93K2-1 from the pack ice region N of

Kotel'nyy Island contain also mud clasts.

Normally up to 5 box cores per station were taken. At some stations it occurred that the cores showed significant unconformities. This is probably due to the ship drifting over different kinds of sediments. A striking example for this is station IK9340, where the box core IK9340-5 recovered only 13 cm of silty to clayey sand, while sediment core IK9340-9 (recovery 29 cm) revealed a 16 cm horizon of black clay with intercalated sandy layers (see core descriptions for further examples). At the other stations the box cores yielded a similar length and lithology. The upper parts of the kastenlot cores correlate with the corresponding box cores regarding lithology.

Smear Slide Analyses

These investigations concentrated on the general sediment composition, e. g. siliciclastic and biogenic components, and rough estimates of mineral distribution. The results of all smear slide analyses are summarized in Tab. A6.

In general, quartz is the dominant mineral. Of siliciclastic components, feldspar, rock fragments, mica and heavy minerals are common; accessory minerals were not studied. Biogenic components are rare: Diatoms, arenaceous foraminifera, nannofossils and sponges spicule were found. Plant debris is common in all samples.

In figure 57 the smear slide data of sediment core IK9309-6 are presented in combination with the core description. Quartz as the dominant mineral is excluded to emphazise the relative changes of other components. While the feldspar content is rather uniform throughout the whole core, the changes of biogenic components are striking. Diatoms are abundant in the upper 40 centimetres of homogeneous silty clay. In the layer between 40 and 100 cm below the sea floor, diatoms are rare or even missing (at 1 m). Agglutinated foraminifers and sponge spicules occur in this section. In contrast to the upper 40 centimetres, the plant debris content is very low here. Terrestrial input seems to be reduced. Diatoms are rare to common between 100 cm and the bottom of the sediment core. Here the amount of plant debris is high again. The clayey sand from 147-158 centimetres is characterized by a high feldspar, mica and plant debris content, which indicates a strong terrestrial input.

Thus, the sediments of the Laptev Sea are dominated by fine-grained, siliciclastic components. Quartz, feldspar, rock fragments (also coal), heavy minerals, and mica are common minerals while, except for plant debris, biogenic components are rare.

Long Sediment Cores

In the following we will describe six long sediment cores (IK9309-6, IK9321-8, IK9324-5, IK9327-9, IK9334-10, IK9373-10).

Core IK9309-6 recovered a 1.58 m sediment sequence from the eastern Laptev Shelf. It consists of 1.45 m silty clay covered by a thin surface layer of brownish mud. The colour of the silty clay gradually changes from dark gray into black. The column ends in an 11 cm thick, black sandy clay layer being rich in well preserved plant debris, which emitted H_2S. This sediment can be

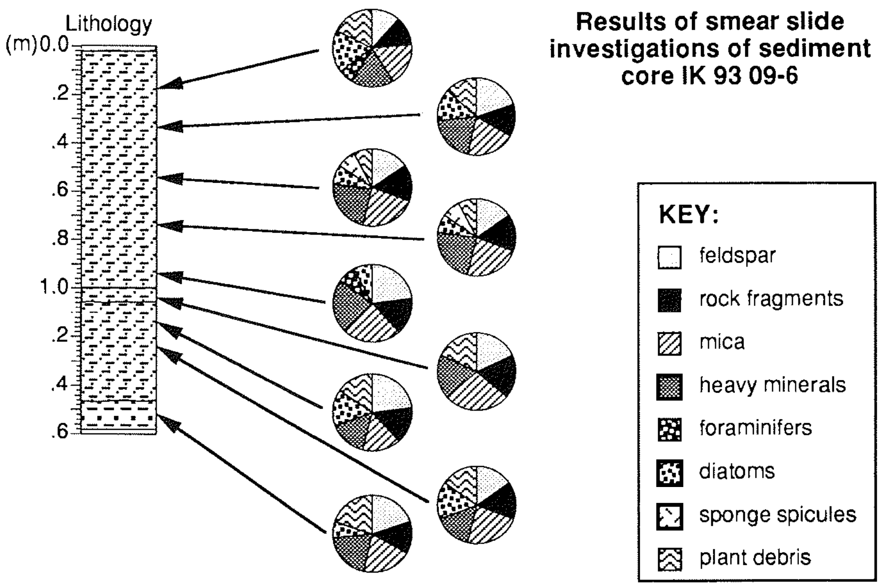


Fig. 57: Results of smear slide investigations of sediment core IK9309-6. The pies show the relative abundance of components without quartz.

regarded as delta sediment of the former Yana river.

Core IK9321-8 from the Lena valley contains 85 cm of homogeneous gray silty clay. Ice crystals are abundant 18 cm below the top of the core with crystal sizes increasing with depth. At the bottom of the sequence, the platy, angular crystals reach 1 to 3 cm in length. Many crystals lie perpendicular to lamination. We interprete this as the permafrost boundary, which could not be penetrated at other stations. Since we did not find ice crystals in the previously taken box cores of station IK9321, the vessel must have drifted to a place where the permafrost boundary was certainly deeper.

At station IK9324 in the Olenek mouth region, sediment core IK9324-5 recovered 10 cm more than the box core IK9324-3 and contains silty clay down to the core base. Core IK9327-9 of the same area contains 95 cm of dark gray silty clay with common bivalve shell fragments.

Sediment core IK9334-10, which was recovered near Stolbovoy Island, consists of 1.12 metre dark gray to very dark gray clay interrupted by a diffuse silty layer. IK9373-10 southwest of Bel'kovskiy Island recovered 1.29 metre of very dark gray, silty clay with cyclically occurring, weak laminated layers. Some layers show open burrows down to 90 cm.

The Depositional Environment of the Laptev Sea

In general, the sediment samples of all over the Laptev Shelf show some differences in sediment distribution. The lithologic variations of sediments according to bathymetry, core recovery and position are shown on the basis of two transects (Fig. 58 and 59).

The E-W-profile (laltitude 74°30'N) starts at the Khatanga mouth (Fig. 58). This profile crosses the submarine valleys of the Olenek, Lena, and Yana rivers and several shoals. Core lengths and the sediment features indicate a close relationship between sediment type, core penetration and water depth. The longer cores of the deeper valley regions consist of fine-grained sediments. These are the only locations where long sediment cores were successfully recovered.

The Transect IV profile (Fig. 59), which extends from North to South and which is one of five profiles perpendicular to the shore, elucidates the sediment distribution in the eastern Lena Valley. It includes also the sediment core IK9321-8, which penetrated the permafrost boundary at 18 cm below sea floor. In the deeper valley region below a water depth of 40 metres, the box core IK9370-6 ends in a sandy layer. Clays and silty clays dominate the whole profile except for the near shore station IK93Z4.

6.4 Physical Properties of Near-Surface Sediments in the Laptev Sea

Kassens, H. and Benthien, A.

Physical properties of marine sediments (e.g. shear strength, density and water content) are influenced by sediment composition, sedimentation rates increasing overburden pressure, and diagenesis. That is, the variability of physical properties is mainly controlled by hydrographic and oceanographic changes. Thus, they are supposed to be a good tool for deciphering the paleoceanographic history of the Laptev Sea.

Unfortunately, our knowledge of physical properties of Arctic deep-sea sediments is very limited. This is espeacially true for the Laptev Sea where to our knowledge no Russian database exist. To fill this gap, our investigations will focus on:

- the development of a ground truth database of sediment physical properties;
- the relationship between physical properties and paleoceanographic processes;
- the correlation between physical properties and high resolution seismic records;
- present and past sediment flux determinations;
- the estimation of the state of consolidation in order to answer the glacial history of the Laptev Sea.

Physical Property Methods

Physical property measurements were made on the box cores (sampling frequency of 2 cm), and 'kasten' cores (sampling frequency of 2 - 5 cm).

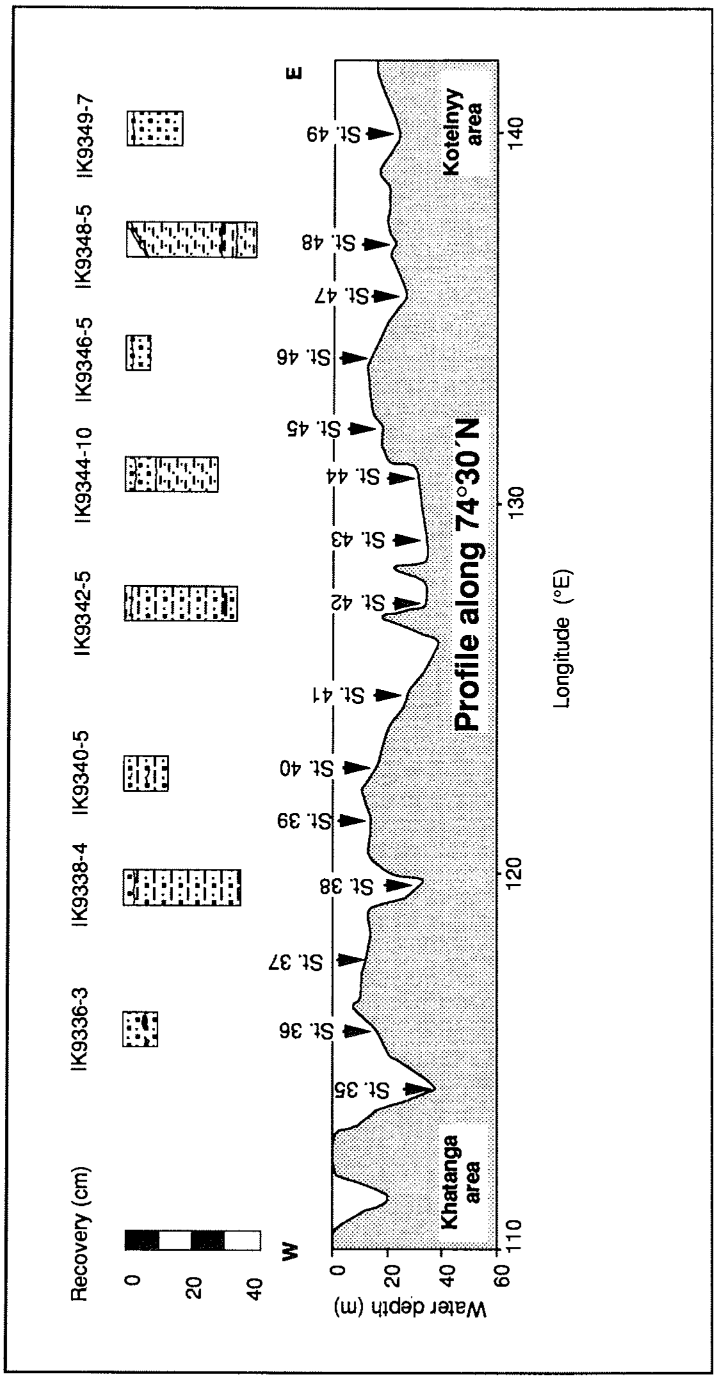


Fig. 58: W-E profile of the Laptev Sea along 74°30'N and descriptions of selected sediment cores (see also legend in Tab. A3). The sedimentological stations of the TRANSDRIFT I expedition are marked by arrows.

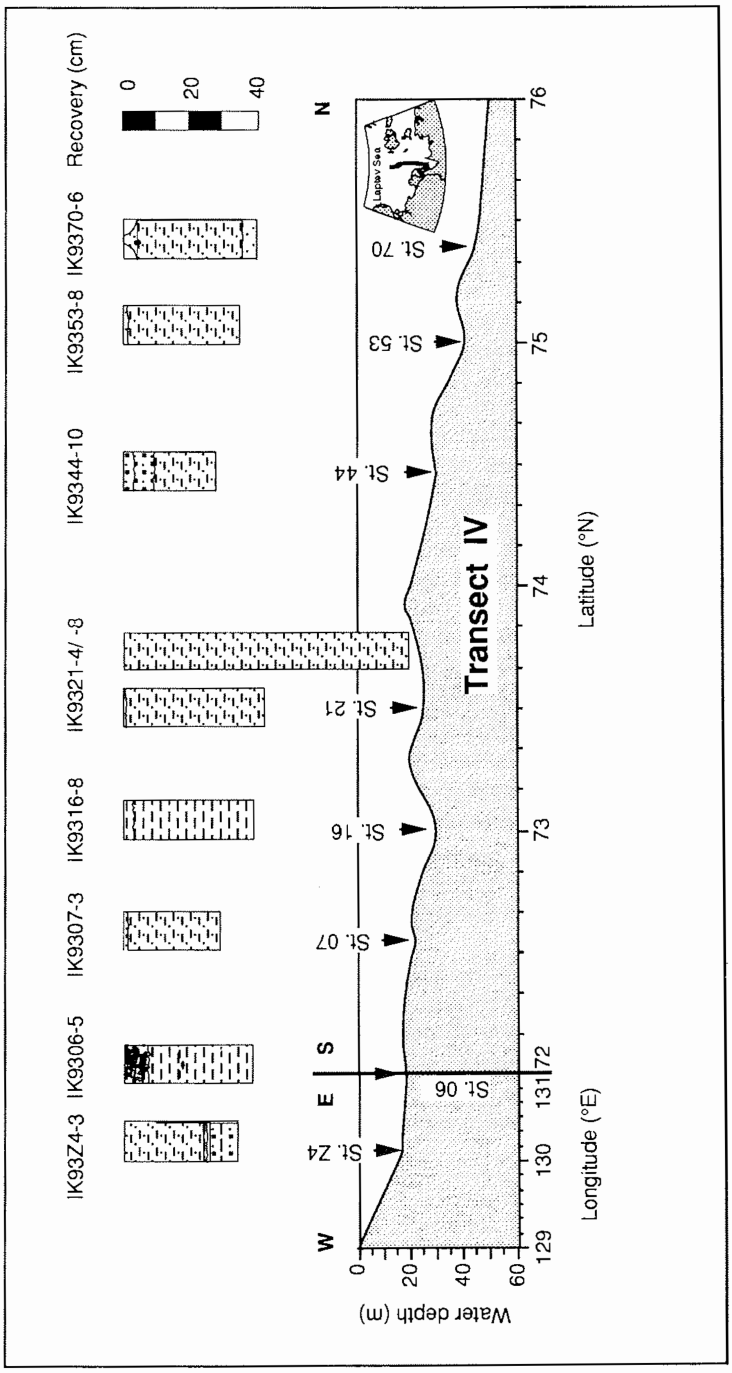


Fig. 59: N-S profile of the Laptev Sea E of the Lena Delta and descriptions of selected sediment cores (see also legend in Tab. A3). The sedimentological stations of the TRANSDRIFT I expedition are marked by arrows.

Because the quality of physical property measurements is strongly affected by sample disturbance (e. g. moisture loss), all measurements have been carried out on board immediately after core retrieval. The measurements were made only on fine-grained sediments.

Physical properties measured on board included water content, and wet bulk density. From these basic properties, other sediment phase relationships can be derived (e. g. void ratio, porosity, dry density). The so called index properties can be determined from the direct measurement of the total mass of the sample (M_t), the dry mass of the sample (M_d), and the total volume of the saturated sample (V_t).

To compensate for the ship's motion, mass is determined by means of a technique of differential counterbalancing on twin top loading electronic balances. The ship's motion is partially compensated by a reference balance (A), which has a matched load to the sample balance (B) with the sample of unknown mass (M_t). The balances are configured with an analogic 0-5 volt output over a 50 g range. The voltage output of each balance is directed to a differential amplifier. The voltage difference is digitized and then processed on a microcomputer. This method of differential counterbalancing is described by Childress and Mickel (1980). The computerized precision electronic balance system (Lutze et al., 1988) used during this cruise was kindly provided by M. Sarnthein, Univ. of Kiel.

A known mass (M_k), ideally within 1 g of the unknown mass, is placed on balance A. The unknown (M_t) is placed on balance B. Then the differential signal is assumed to be the difference (in volts) between M_k and M_t. This differential voltage is averaged over time (several cycles of ship's roll period). The differential mass (M_{diff}) is calculated by linear regression from the calibration curve. The unknown mass is then $M_t = M_{diff} + M_k$. The balance system was used in a non-counterbalance mode simply by using zero as the known mass.

Sample volume was determined according to the constant volume method (tube of 10cc). The tube was carefully pushed into the sediment, then cut out, trimmed and weighed.

After the determination of the total (wet) mass and volume, the samples were dried. Water content is reported as a percent ratio of water to dry mass (w_d). In addition, because any dissolved salts contained in the pore fluid will change phase during the drying of the sample, a correction for pore fluid salinity (r) must be included in both calculations of water content (Noorany, 1984). If, for example, pore fluid salinity is 35 ‰, then r =0.035. The formulations are as follows:

$$w_t = (M_t - M_d)(1 + r)/M_t \quad (1)$$

$$w_d = (M_t - M_d)/(M_d - rM_t) \quad (2)$$

Bulk density (r) is the density of the total sample, including pore fluid or:

$$r = M_t/V_t \quad (3)$$

No corrections are required for this calculation.

First results

For the first time we were able to carry out physical property measurements of near surface sediments of the Laptev Sea. The physical property working program was conducted on a total of 27 sediment cores (Tab. A 4). Thus, we have extended our physical property database from the central Arctic Ocean to the Siberian shelf seas, which are supposed to be important sediment source areas for the entire Arctic Ocean.

In near surface sediments of the Laptev Sea (average for the upper 15 cm) the values of water content vary between 29 % (IK93 KI-1) and 97 % (IK93 21-4) and the values of wet bulk density vary between 1,5 g/cm^3 (IK93 16-8) and 2,0 g/cm^3 (IK93 KI-1) (Fig. 60). High water content values and low wet bulk density values were found in regions which are dominated by clayey sediments, such as along the Olenek, Lena, and Yana Valley. If compared to other polar shelf regions, e. g. to Barents Sea or Laptev Sea, sediments show high wet bulk density and low water content.

The long sediment cores investigated in the Laptev Sea (Tab. A2) show physical property variations which are a reflection of the grain size and sediment source variation. In general, these records do not have a clear trend with depth below sea floor (Fig. 61). However, as a result of the shallow offshore permafrost boundary, which we already penetrated 12 cm below the sea floor at station IK9321-8, and/or of frequent sand layers in the vicinity of the Lena Delta (Tab. A3), our longest physical property record we were able to obtain is only 1,5 m long.

Our investigations in the Laptev Sea have shown that near surface sediments of the Laptev Sea are normal to under consolidated. Changes in physical properties correspond to lithologic changes. The water content and density profiles show little trend with depth below seafloor. This suggest high sediment accumulation rates in the Laptev Sea.

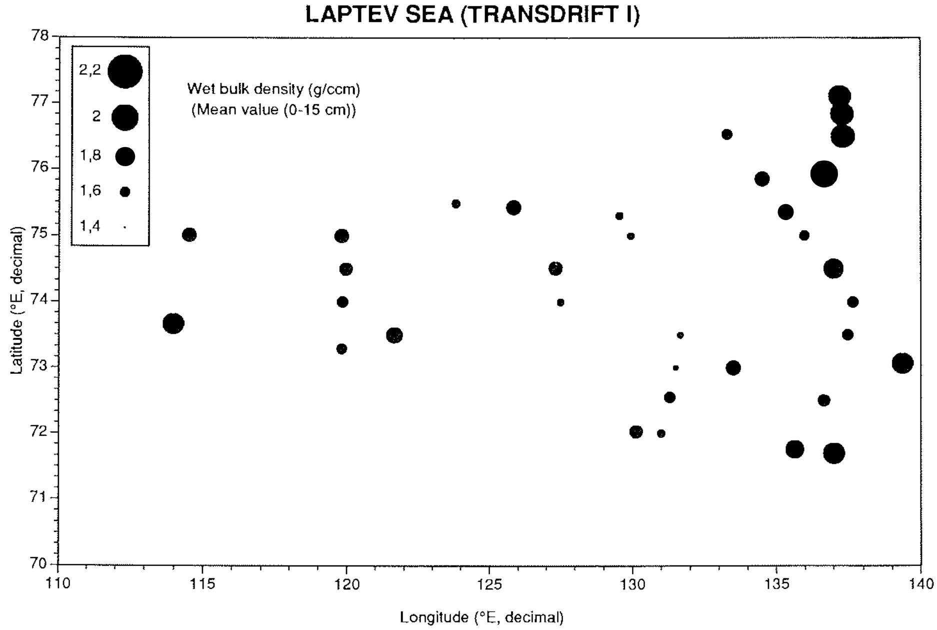
6.5 Ecological-Geochemical Studies

Jakovlev A.

The studies of the Arctic seas have a long history, but in spite of this the geological and geochemical knowledge of the Laptev Sea shelf considerably lags behind that of the western Arctic Shelf seas. This is due to both a comparatively difficult access and specific features of the ice regime of the area. Most data concern only the southern and central parts of the Laptev Sea shelf, which are characterized by a relatively less severe ice situation. In addition, the preceding studies were carried out according to different methods and did not always have a comprehensive ecological landscape character. There are no data on the components of technogenic influence on bottom sediments, too.

The goals of the observations were to carry out full-scale lithological and ecological-geochemical studies of recent sediments of the Laptev Sea shelf in order to find out the characteristic features of the lithological composition of recent sediments as well as the parameters of technogenic pollution of bottom sediments and mass forms of zoobenthos.

LAPTEV SEA (TRANSDRIFT I)



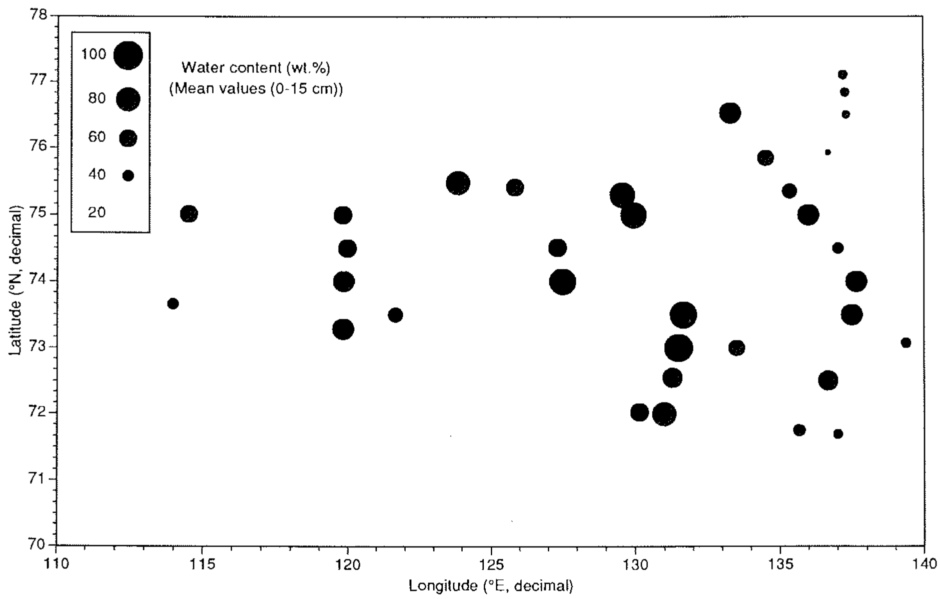


Fig. 60: Distribution pattern of physical properties in near surface sediments of the Laptev Sea.

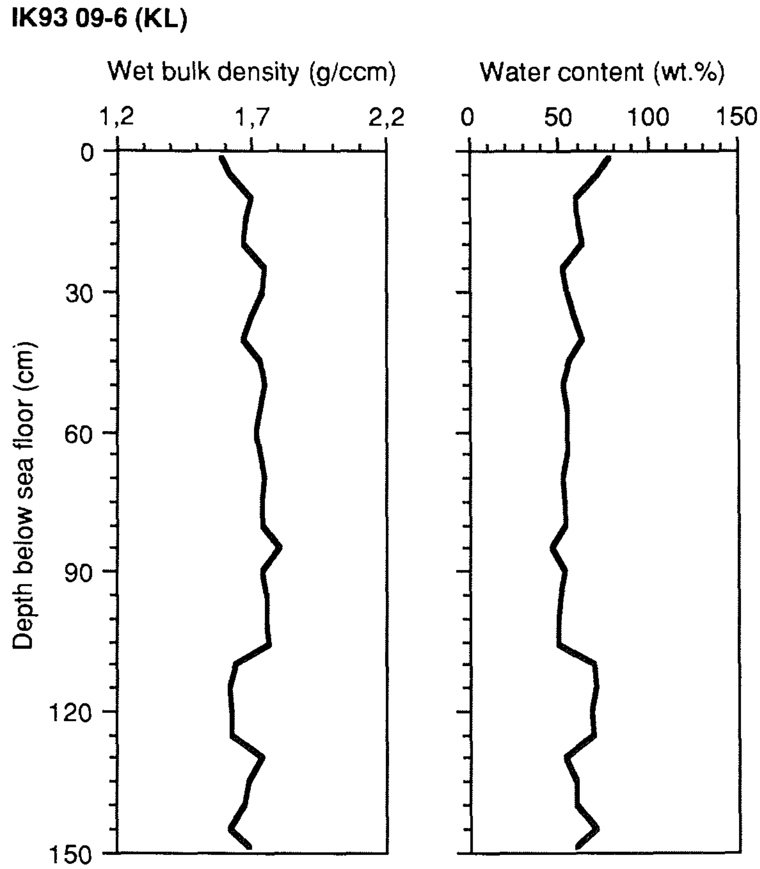


Fig. 61: Physical properties of sediment core IK93 09-6 from the eastern Laptev Sea.

Work Program and Research Methods

The field works were carried out at stations which were chosen according to the "Instruction for the organization and execution of a small-scale geological shelf survey on the scale of 1:1000000" (1990) and to the "Temporal methodical recommendations for ecological landscape mapping during the ecological shelf survey" (1989). The following works were carried out:

- bottom sampling of surface sediments was made with the Van Veen (0.1 m^2) and the Petersen (0.025 m^2) grab and with a box corer; at the same time hydrobiological benthos sampling was carried out;
- macrozoobenthos sampling was made with a small Sigsby trawl in order to investigate technogenic pollution in the Laptev Sea.

Directly aboard the vessel a lithological sediment description was made, including a visual determination of the granulometric sediment type. Furthermore, sampling was made for laboratory determinations. The sediment samples which were used for lithological-geochemical laboratory studies were sealed in polyethylene bags. Samples for the determination of polyarometic hydrocarbons were put into sealed glass flasks. Sediment samples for the analysis of technogenic components were stored in special titanum and teflon tubes. The benthos samples were dried at a temperature of 105° C and were sealed in polyethylene bags.

Preliminary Results.

During the TRANSDRIFT I expedition aboard the R/V *Ivan Kireyev* we have occupied 42 stations and have taken 250 samples and specimens, including 46 samples for lithological-geochemical studies, 41 samples for the studies of petroleum hydrocarbons, 41 samples for the determination of polyaromatic hydrocarbons, 35 samples for the analysis of technogenic components, 21 samples of iron-manganese concretions and incrustations and 9 samples of mass benthos forms.

According to the data of preliminary lithological determinations, fine-grained sediments are most widespread in the Laptev Sea. Pebble and gravel are typical of the near shore zones and also of the south-western shelf of the Laptev Sea. Authigenic iron-manganese crusts are mainly observed in the central and south-western part of the Laptev Sea shelf. Timber inclusions in bottom sediments are also noted. They are mainly characteristic of river mouthes of large rivers and particularly of the river Lena.

6.6 Geochemistry

Hölemann, J. A. and Sanders, D.

Pack ice with incorporated sediments and biogenic particles is a common feature in the Arctic. It is assumed that the Laptev Sea is one of the most important areas for the formation of such 'dirty sea ice' (Wollenburg, 1993; Nürnberg et al. in press). However, recent works have shown that a precise source localisation is difficult, if it is only based on the investigation of sedimentological traces in dirty sea ice (Wollenburg 1993). Thus, a detailed geochemical characterisation of sea ice and incorporated particles will give a new methodological approach. The combination of sedimentological and geochemical data and observations of dirty sea ice is a key for the

- localisation of source areas,
- reconstruction of recent and ancient ice drift patterns,
- understanding of formation processes which lead to the incorporation of particulate and dissolved substances into the ice.

The TRANSDRIFT I expedition allows us to carry out an extensive sediment and water sampling programme within the Laptev Sea for the first time. The subsequent analysis of the minor and trace elements and of PCB composition will form the cornerstone for comparative studies of characteristic geochemical features in different matrices within the Laptev Sea and the pack ice of the Transpolar Drift.

The sampling programme for PCB and trace metal analysis focused on the Siberian rivers Khatanga, Anabar, Olenek, Lena and Yana with their high freshwater and sediment input. Therefore, samples were taken from coastal areas near to the river mouth and on selected N-S transects through the Laptev Sea.

First measurements of PCBs in ice, water and sediments of the Laptev Sea were carried out within the scope of the ESARE expedition in 1992. PCB concentration was surprisingly high compared to other Arctic seas. A distinct variability within the spectrum of PCB congeners points to different source areas. After the TRANSDRIFT I expedition it will be possible now to identify the different sources and transport pathways of PCBs through the Laptev Sea. The results will also lead to a better understanding of geological processes like the modern sedimentation regime.

Detailed investigations of pore water chemistry complete the analysis of trace metals and PCBs in the solid phase of the bottom sediments and give further information about the input and cycling of nutrients within this Arctic shelf sea.

Working programme

1.) Trace elements

During this cruise, 25 sediment (upper 5 cm), 20 suspended matter and 20 water (both at 4 m water depth) samples were taken in the coastal area and on a selected N-S transect through the Laptev Sea. The detailed positions of all sampling sites are given in Table A2. Surface-sediment samples were taken with a spade box core and were stored frozen for subsequent analysis.

Water samples for trace element analysis were taken with a Teflon water sampler (Hydro-Bios) with 2 l pre-cleaned polyethylene sampling bottles hung on a plastic-coated hydrowire. Sampling was carried out from a dinghy several 100 meters away from the ship to avoid contamination. During heavy weather samples were taken at the bow of the research vessel while it was in slow forward motion (about 0.5 kn).

Two liters of sea water were filtered through acid pre-treated 0.45 µm Nuclepore filters to collect particulate matter. For that purpose a pressure filtration (Nitrogen 5.0) in a transportable clean room laboratory (clean bench) was used. Filters were stored frozen for subsequent analysis while the filtrate was acidified to a ph of about 2.

Final analysis will be done at the Research Center Geesthacht (GKSS) including salt-matrix separation and pre-concentration of the water samples followed by Total Reflection X-Ray Fluorescence (TXRFA). Elements measured in sea water include V, Mn, Fe, Al, Co , Ni, Cu, Zn, Se, Mo, Cd, U and Pb.

For comparative studies of sediments with different grain size compositions, it is necessary to measure a standardized grain size fraction. In our study the < 20 µm fraction will be used for the TXRFA-determination of about 30 elements.

2.) Chlorinated Biphenyls

During the expedition samples of sediment surface for chlorinated biphenyl (CB) analysis were taken in all parts of the Laptev Sea (Tab. A2). Additional measurements of the chlorinated biphenyl content in the water column (dissolved) and in the suspended particular matter (adsorbed) were made near the river mouth and along N-S transects that follow the water outflow of the Lena.

For the PCB analysis in sediments, about 50 g of sediment surface were taken with a spade box core at each station. In order to gain information about variations of the PCB input, sediment samples of the upper 40 cm sediment column were taken near the estuaries and along the Lena N-S transect. All samples were put into pre-cleaned Petri-dishes and were stored for analysis at -20° C.

In order to study the present PCB contamination patterns in the Laptev Sea, water and suspended matter samples were taken by means of an in situ pumping system, which consisted of a Teflon-filter-box, a pumping-unit, an adsorber-column and a flux-counter. The samples were taken at different water depths (4 m to 15 m; for details see station list). The suspended particular matter was collected on pretreated glassfibre-filters that were frozen at -20° C immediately after sampling. The dissolved organic compounds were adsorbed on XAD-columns that were stored cool.

For the analysis of chloinated biphenyls, all samples will be analysed by means of Liquid Chromatography (LC) and High Performance Liquid Chromatography (HPLC) with an Electron-Capture-Detector (MDGC/ECD) in connection with Multidimensional Gaschromatography. All measurements will be carried out at the Institute of Marine Research in Kiel.

6.7 Pore Water Geochemistry

Langner, C.

The extensive continental shelf around the Arctic Ocean plays an important role in the cycle of nutrients and should be considered a factor of the global oceanic material flux and budget. Reaction rates during the degradation of organic substances influence the material fluxes through the sediment / bottom water interface in the same way as the early diagenetic zones in sediments. The primary diagenetic processes of dissolution and precipitation create numerous resultant reactions, which are indicated by the development of new minerals.

Pore waters recovered from sediment cores of various subregions (river mouth of Lena and other Siberian rivers, shelf regions with a large freshwater input, shelf regions where river run-off is modified by mixing with saline waters and shelf regions which are influenced by brine water during the freezing period) will be investigated geochemically. The detailed positions of all sampling sites are given in Tab. A2.

Working Programme

Sediment samples for the extraction of pore water were taken in fixed intervals: from 0 to 4 cm every centimetre, from 4 to 10 cm every 2 cm, from 10 to

20 cm every 3 cm, from 20 to 30 cm every 5 cm and from 30 to 50 cm every 10 cm.

Pore water was extracted with a centrifuge(15-20 min, 4500/min). After centrifugation all pore water samples were filtered through 0.45 µm filters (Zellulose acetat). For storage all samples were acidified with 50 µl 1N HNO_3.

The analysis of sulphate, sulphide, amonium, phosphate, manganese, iron, calcium, and silicium will be carried out at the AWI-Potsdam .

6.8 All year round sea-floor temperature and conductivity measurements

Hölemann, J.A.

Sea-floor temperature and chemistry are unique in shallow arctic seas. Temperatures can be less than -1.0° C during a long time of the year, and water at the bottom can vary from fresh to highly saline. Factors which have an influence on this are local freshwater contributions, bottom topography, sediment properties and formation of cold, dense bottom water during the seasonal growth of ice. Cold bottom waters are also a prerequisite for the formation of anchor ice at the sea floor and suspension freezing in the water column. These processes are probably the most important factors which controll the incorporation of sediments into newly formed ice (Osterkamp & Gosink, 1984). In order to understand these conditions and processes, three self-contained recording instruments were deployed at the sea floor north of Kotel'nyy (Tab. 3) for the period of one year.

Tab. 3. Station list of the deployed moorings in the Laptev Sea

Station	Location	Water depth
Kireyev I: West off	75°56,843 N	19,5 m
Kotel'nyy Island near	136°44,833 E	
Bel'kovskiy Island		
North off Kotel'nyy Island	76°30,068 N	25 m
(Station 82 A)	137°20,304 E	
Kireyev II: North off	76°49,697 N	29 m
Kotel'nyy Island	137°17,898 E	

The instrument packages include two temperature sensors and a conductivity cell (Figure 62). One temperature sensor is connected with a 1-m cable so that it can be placed at the sea floor. All units were set to make observations every three hours for a period of one year. The instruments were cast into a concrete base together with an acoustic beacon to recover the units. A small sediment trap with an opening of 0.143 m^2 was positioned 5 m above the concrete base in order to take samples of suspended matter and to estimate the yearly particle flux.

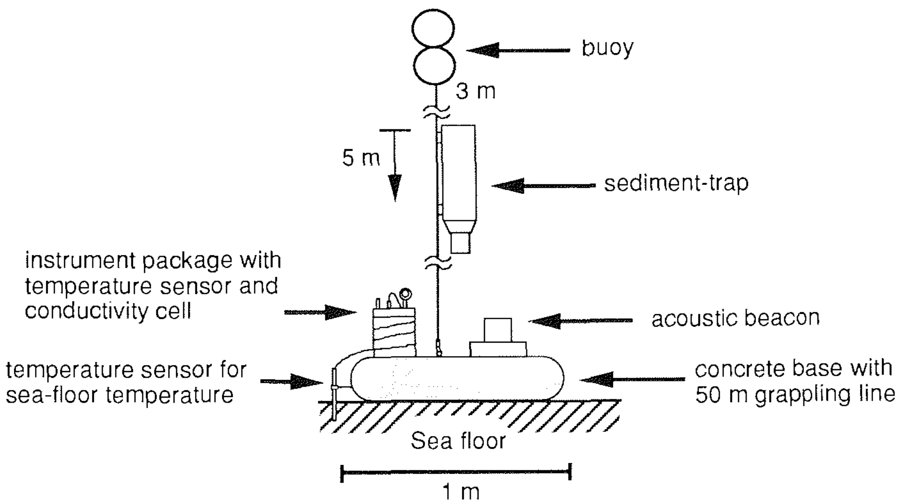


Fig. 62: Diagram of the deployed mooring in the Laptev Sea

7. CONCLUSIONS

Kassens, H. and Karpiy, V.

Preliminary shipboard work indicates that interesting results can be anticipated. Distinct differences in environmental conditions exist between the western and eastern Laptev Sea. Significant results of TRANSDRIFT I follow: During the short summer season, the Laptev Sea is characterized by a unique oceanographic situation because Atlantic, Pacific and Arctic water masses are traceable. The distribution of these water masses is controlled by the freshwater input of the large Siberian river systems draining into the Laptev Sea. The river water is warmer and much less saline than sea water and spreads over the Laptev Sea as a low-salinity surface layer carrying much of the suspended load of the river. As a result of the Lena River outflow, the water column of the eastern Laptev Sea shows remarkable temperature and salinity gradients (Fig. 63). Note that sea-floor temperatures were much lower than the water temperatures just a few centimeters above the sea floor. In general, sea-floor temperatures decrease with increasing distance from the coast.

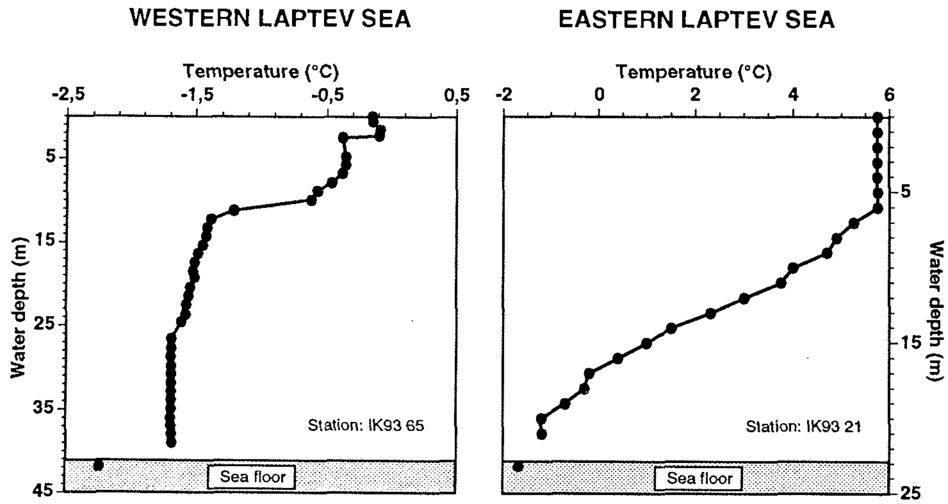


Fig. 63: Vertical temperature profiles of the Laptev Sea water column. The freshwater of the Lena (eastern Laptev Sea) and the Kathangar (western Laptev Sea) is warmer and much less saline than sea water and spreads over the Laptev Sea as a low-salinity surface layer. Note that sea-floor temperatures were much lower than the water temperatures just a few centimeters above the sea floor.

This complex oceanographic situation is well documented in the distribution pattern of benthic organisms and sea-floor sediments. Preliminary biological results indicate, for example, the existence of gradients in species distribution and abundance in response to increasing water depth and the occurrence of marine and brackish water masses according to the fresh water influence of the Lena. Distinct gradients exist along the transects from the most shallow to the deepest stations on the shelf with characteristic zonations of different species in special taxonomic groups, e. g., echinoderms and crustacians. The zoogeographic origin of the species reflects the influence of Atlantic and Pacific water masses in the inner Laptev Sea. High numbers of Atlantic species are in the western Laptev Sea in contrast to the dominance of Pacific species in the eastern Laptev Sea.

The sedimentary regime of the Laptev Sea is characterized by primarily fine-grained, near-surface sediments. Dropstones are rare in the vincinity of Kotel'nyy Island. Sedimentation in the inner Lapten Sea is controlled mainly by river run-off, which can be shown by the sediment distribution. Brown to light grey sandy silts are typical of the western Laptev Sea, whereas dark grey to black silty clays containing up to 2 wt.% of organic carbon are typical of the eastern Laptev Sea. Past climate changes are reflected in laminated sediments as well as in distinct facies changes.

According to sub-bottom echograms (30 kHz) west of Kotel'nyy Island, the postglacial sediment cover varies between 10 and 12 m. Therefore average sedimentation rates are approximately 1 m per thousand years. Because of these high sedimentation rates, long sediment cores from this location can provide excellent samples for the study of Laptev Sea paleoceanography and the late Quaternary variability of Siberian river input into the Arctic Ocean. Unfortunately, during TRANSDRIFT I we were not able to obtain sediment cores longer than 2.5 meters. We believe that limited core recovery during the expedition was due to the base of permafrost, which has already been indicated by the low sea-floor temperatures (Fig. 63). This was confirmed in the Lena Trough, where we penetrated the permafrost boundary at a depth of 12 cm below the sea floor. The frozen sediments revealed platy, angular ice crystals reaching a length of more than 3 cm at the core base.

Ice, which covers the Laptev Sea for almost nine months each year, seems to be of great importance for the sedimentary environment. Side-Scan-Sonar records and 30 kHz echograms demonstrate that the sediments of the shallow shelf area are highly disturbed by the action of grounding ice (Fig. 64). Linear bottom features as well as traces of 'dancing' icebergs, which have cut into the sediments as deep as six meters, have been found west of Kotel'nyy Island and west of the Lena Delta (Fig. 54, 55, 56). During TRANSDRIFT I we were able to observe icebergs and traces of grounded ice in water depths up to 40 meters. These results show that grounding ice contributes considerably to sediment transport on the Laptev Sea shelf.

The occurrence of surficial iron-manganese crusts and nodules (diameters up to 6 cm) was highly impressive. These crusts not only covered the sea floor near some stations, but also covered worm tubes and bivalve shells. East of the Lena Delta, for example, we recovered a layer of worm tubes 7 cm thick on the top of a box core (IK9306-5). In addition, we observed living bivalves whose shells were completely cemented by iron-manganese. Thus, they were burried alive because they were no longer able to open themselves. The origin of the iron-manganese crusts is still under discussion.

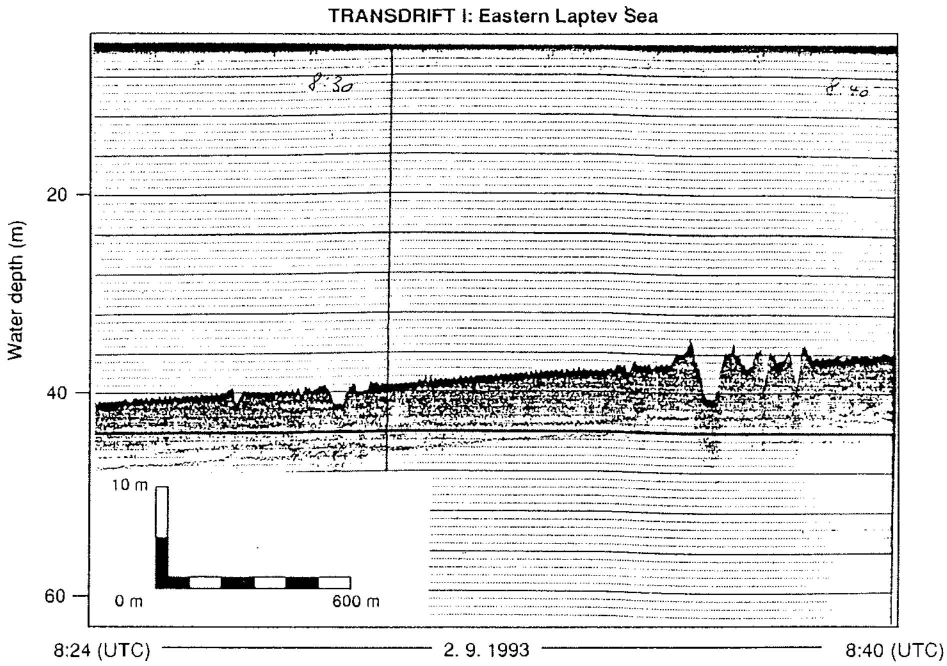


Fig. 64: 30 kHz echogram of the eastern Laptev Sea showing that the sediments of the Laptev Sea are highly disturbed by the action of grounding ice.

8. ACKNOWLEDGEMENTS

This scientific expedition would not have been possible without the support of numerous colleagues in Germany and Russia. Our hearty thanks go to our colleagues at the Alfred Wegener Institute for Polar Research in Bremerhaven, the Arctic and Antarctic Research Institute in St. Petersburg, the GEOMAR Research Center for marine Geosciences in Kiel, the Hydrographic Department of Arkhangels'k, the Institute for Polar Ecology in Kiel, and the Lena Delta Reserve in Tiksi for their cooperation before and during the expedition. Without this close cooperation it would not have been possible to conduct this logistically challenging expedition. We particularly wish to thank A. Bakina, Prof. Dr. I. Frolov, Prof. Dr. D.K. Fütterer, H. Heyn, Dr. S. Priamikov, Prof. Dr. L. Timokhov and Prof. Dr. J. Thiede.

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Furthermore, we wish to thank the crew of the RV *Ivan Kireyev* for the outstanding fulfillment of their responsibilities during the expedition. Our thanks go also to the crew of the RV *Polarstern* for their logistic support during our meetings in the Laptev Sea.

Contact with our home bases was, inspite of the difficulties of establishing radio contact, possible on board the RV *Ivan Kireyev.* A. and N. Bakina and O. Runze always succeeded in finding ways of communication.

The English manuscripts of this cruise report were kindly improved by D. Krüger, who learned a lot about research in the scope of GLOBAL CHANGE during this time.

Last, but not least, we also wish to express our gratitude to our ship's doctor, Dr. R. Benthien (Rudi). With his vast medical and seafaring experience he was a constant source of support and advice.

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10. APPENDIX

Tab. A1: List of participants of the TRANSDRIFT I expedition

Scientific Party			
Karpiy, Dr.	Valeriy Y.	AARI	Chief of Expedition,
Oceanography			
Kassens, Dr.	Heidemarie	GEOMAR	Co-Chief Scientist, Geology
Antonow,	Martin	BAF	Geology
Benthien,	Albert	GEOMAR	Geology, Navigation
Benthien, Dr.	Rudolf		Physician, Navigation
Blumm,	Evgeny M.	AARI	Meteorology
Bovkun,	Leonid A.	NPO	Hydrochemistry
Chigak,	Maksim F.	AARI	Hydrochemistry
Churun,	Vladimir N.	AARI	Oceanography
Fentchenko,	Julia M.	AARI	Meteorology
Ipatov,	Alexander Y.	AARI	Oceanography
Heinze,	Bertram	GEOMAR	Geology
Hölemann, Dr.	Jens A.	GEOMAR	Geochemistry
Knickmeier,	Katrin	IPÖ	Biology
Langner,	Constanze	AWI-P	Geochemistry
Lebedev,	Nikolay V.	AARI	Oceanography
Lindemann,	Frank	GEOMAR	Geology
Masalkin,	Vikentyi E.	AARI	Meteorology
Neufeld,	Sergej	GTG	Technician
Petryashov,	Viktor V.	ZISP	Biology
Pivovarov,	Sergey V.	AARI	Hydrochemistry
Semuschyn,	Dmitry S.	AARI	Hydrochemistry
Schmid,	Michael K.	IPÖ	Biology
Sanders,	Dirk	IFM	Marine chemistry
Vogt,	Christcph	AWI	Geology
Yakovlev,	Alexander V.	VNIIO	Geology
Ships crew			
Katayev,	Albert A.	HDA	Captain
Slobin,	Vitaliy G.	HDA	Chief Mate
Perepelkin,	Vadim N.	HDA	2nd Officer
Mineev,	Alexander R.	HDA	3rd Officer
Dubovik,	Vladimir I.	HDA	Radio Officer
Matigorov,	Valeriy A.	HDA	Chief Mechanic
Dolgopolov,	Valeriy A.	HDA	2nd Mechanic
Ivanov,	Viktor M.	HDA	3rd Mechanic
Vachtomyn,	Sergey E.	HDA	4th Mechanic
Lobanov,	Yuriy	HDA	Chief Electromechanic
Ratchenko,	Viktor M.	HDA	Boatswain
Chetverikov,	Vladimir V.	HDA	Sailor
Chemesov,	Sergey M.	HDA	Sailor
Gergel,	Alexander N.	HDA	Engineer
Myakenky,	Anatoly M.	HDA	Engineer
Odinokov,	Alexey I.	HDA	Engineer
Rudinsky,	Vladimir A.	HDA	Turner
Sikachev,	Sergey V.	HDA	Electrical Engineer
Ilyin,	Gennady F.	HDA	Chef
Pusyrnyi,	Pavel A.	HDA	Cook
Rocheva,	Lubov I.	HDA	Stewardess
Fedorchenko,	Irina P.	HDA	Stewardess

Addresses

AARI	Arctic and Antarctic Research Institute Uliza Beringa 38 St. Petersburg 199226
NPO	NPO "Taifun" Institute of Experimental Meteorology Pr. Lenina 82 Obninsk, Kaluga region, 249020
VNIIO	All-Russian Research Institute for Geology and Mineral Resources of the World Ocean VNIIOkeanologia Uliza Maklina 1 St. Petersburg 190121
ZISP	Zoological Institute Russian Academy of Sciences Universitetskaya nab. 1 St. Petersburg 199034
HDA	Hydrographic Department Ministry of Transport of Russia A. Bakin Uliza Mayakovskovo 12 Arkhangelsk 163020
AWI	Alfred-Wegener-Institut Columbusstraße D - 27568 Bremerhaven
AWI-P	Alfred-Wegener-Institut Forschungsstelle Potsdam Telegrafenberg 51, A 43 D - 14401 Potsdam
BAF	Institut für Geologie TU Bergakademie Freiberg Cotta-Str. 2 D - 09596 Freiberg
GEOMAR	GEOMAR Wischhofstraße 1-3, Geb. 4 D - 24148 Kiel
GTG	GEOMAR Technologie GmbH Wischhofstraße 1-3 D - 24148 Kiel
IFM	Institut für Meereskunde Düsternbrooker Weg 20 D - 24105 Kiel
IPÖ	Institut für Polarökologie Wischhofstraße 1-3, Geb. 12 D - 24148 Kiel

Tab. A2: Station list of the TRANSDRIFT I expedition to the Laptev Sea

No.	Station #		Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
1	60		08.08.´93	23:15	75°00,0´	115°49,0´	0,25-19,25	CTD
				23:30	75°00,0´	115°49,0´	0-20	Hydrochem.
2	61		10.08.´93	01:30	75°00,6´	114°32,2´	42	
				02:04	75°02,0´	114°39,0´	0,25-35,75	CTD-z1
				02:20	75°02,0´	114°39,0´	0-40	Hydrochem. BG,SD,EPN
				08:18	75°00,0´	114°31,0´	0,25-39,00	CTD-z2
	IK9361	-1		6:40 to 6:55	75°00,6´	114°34,9´	42	Dinghi,WS(PCB,Me.)
		-2		09:41	75°00,2´	114°34,1´	42	WS
		-3		8:12 to 10:37	74°59,9´	114°36,8´	42	Dinghi, WS (PCB, Me.)
		-4		10:02	75°00,0´	114°33,3´	36	Bongo
		-5		10:41	74°59,7´	114°33,3´	36	UWP/CTD
		-6		11:05	74°59,6´	114°32,8´	30	Multinet
		-7		11:21	74:59,6´	114°32,6´	45	BG (Geo, 0 cm)
		-8		11:25	74:59,6´	114°32,6´		BG (Geo, 0 cm)
		-9		11:46	74°59,6´	114°32,9´	45	KG (Geo, 30/27 cm)
		-10		12:59	74°59,8´	114°32,0´	45	KG (Geo, 20/20 cm)
		-11		14:43	75°00,7´	114°33,8´	43	KL (Geo, 30 cm)
		-12		15:50	75°01,5´	114°36,1´	43	KL (Geo, 40 cm)
		-13		19:01	75°01,7´	114°39,9´	43	Dredge (empty)
				to 19:11	75°01,8´	114°41,6´		
3	IK9335		10.08.´93	01:10	74°30,3´	114°20,3´	0,25-35,75	CTD
				02:20	74°30,3´	114°20,3´	0-37	Hydrochem.
4	Z-2		11.08.´93	08:59	73°40,0´	113°59,3´	0,25-07,25	CTD-z1
				12:00	73°40,0´	113°59,3´	0,25-07,25	CTD-z2
				14:59	73°40,0´	113°59,3´	0,25-08,00	CTD-z3
				09:15	73°40,0´	113°59,3´	0-7	Hydrochem. BG, SD, EPN
	IK93 Z2			08:00	73°39,9´	113°59,6´	9	
		-1		08:00	73°39,9´	113°59,6´	9	WS
		-2		08:00	73°39,9´	113°59,6´	9	Dinghi,WS(PCB,Me.)
		-3		08:24	73°40,4´	113°59,9´	9	UWP/CTD
		-4		10:27	73°39,9´	113°59,8´	9	KG (Bio, 15 cm)
		-5		11:22	73°40,0´	113°59,8´	9	KG (Geo,17 cm)
		-6		11:36	73°40,0´	113°59,8´	9	KG (Bio, 19 cm)
		-7		11:52	73°40,0´	113°59,8´	9	KG (Geo, 20 cm)
		-8		12:17	73°40,0´	113°59,8´	9	KG (Geo, 20 cm)
	IK93 Sc-1			21:05	73°46,4´	114°06,5´		Side Scan Sonar
				to 22:05	73°51,8´	114°12,7´		
5	IK9326		12.08.´93	04:32	73°60,0´	115°57,8´	0,25-12,75	CTD-z1
				05:56	73°60,0´	115°57,8´	0,50-13,00	CTD-z2
				05:00	73°60,0´	115°57,8´	0-13	Hydrochem. BG, SD,EPN
	IK9326			04:15	73°59,8´	115°54,0´	16	
		-1		04:15	73°59,8´	115°54,0´	16	Dinghi, WS (PCB, Me.)
		-2		04:25	73°59,9´	115°57,7´	16	WS
		-3		04:55	73°59,7´	115°57,6´	16	UWP/CTD
		-4		05:23	73°59,6´	115°57,4´	17	Bongo
		-5		07:08	73°59,2´	115°56,6´	17	Dredge
				to 07:19	73°59,7´	115°57,8´	16	

No.	Station #		Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
		-6		05:15	73°59,6´	115°57,5´	17	BG
6	36		12.08.´93	11:16	74°29,7´	115°59,9´	0,50-13,50	CTD
				11:30	74°29,7´	115°59,9´	0-13	Hydrochem.
	IK9336			11:00	74°29,5´	115°59,6´	16	
		-1		11:10	74°29,5´	115°59,6´	16	WS, CTD
		-2		11:22	74°29,4´	115°59,2´	16	Bongo
		-3		11:30	74°29,4´	115°59,0´	16	KG (Geo, 10 cm)
7	IK9337		12.08.´93	17:31	73°30,1´	117°50,9´	0,25-16.50	CTD
				18:00	73°30,1´	117°50,9´	0-17	Hydrochem.
8	25		12.08.´93	22:41	73°49,9´	117°52,3´	0,50-10,50	CTD
				23:00	73°49,9´	117°52,3´	0-10	Hydrochem.
9	27		13.08.´93	04:12	73°60,0´	119°51,8´	0,50-27,00	CTD-z1
				06:27	73°60,0´	119°51,8´	0,25-21,75	CTD-z2
				04:50	73°60,0´	119°51,8´	0-27	Hydrochem.
	IK9327			04:00	74°00,0´	119°51,7´	30	
		-1		04:12	74°00,0´	119°51,7´	30	Bongo
		-2		04:20	73°59,9´	119°51,7´	30	WS
		-3		04:24	73°59,9´	119°51,6´	30	UWP/CTD
		-4		04:52	73°59,9´	119°51,6´	30	Multinet
		-5		05:09	73°59,9´	119°51,6´	30	KG (Geo, 32 cm)
		-6		05:26	73°59,9´	119°51,6´	30	KG (Geo, 36 cm)
		-7		06:27	73°59,9´	119°51,7´	30	KG (Bio)
		-8		06:47	73°59,9´	119°51,6´	30	KG (Bio)
		-9		07:25	73°59,7´	119°51,7´	30	KL (Geo,100/ 95 cm)
		-10		08:17	73°59,5´	119°52,6´	31	Dredge
				to 08:34	73°58,7´	119°52,5´	40	
10	Z-3		13.08.´93	13:12	73°17,5´	119°50,0´	0,25-08,75	CTD-z1
				14:52	73°17,5´	119°50,0´	0,25-08,75	CTD-z2
				13:30	73°17,5´	119°50,0´	0- 8	Hydrochem.
								BG, SD, EPN
	IK93Z3			13:00	73°17,5´	119°49,9´	12	
		-1		13:00	73°17,5´	119°49,9´	12	WS
		-2		13:20	73°17,5´	119°49,7´	12	KG (Geo)
		-3		13:38	73°17,7´	119°49,9´	11	KG (Geo)
		-4		13:50	73°17,5´	119°49,9´	11	KG (Geo, 33 cm)
		-5		14:25	4,°17,4´	119°49,8´	11	KL (Geo, empty)
11	28		13.08.´93	21:55	73°53,8´	121°31,3´	0,25-09,75	CTD
				22:15	73°53,8´	121°31,3´	0-8	Hydrochem.
12	24		14.08.´93	05:57	73°30,1´	121°40,1´	0,50-07,00	CTD
				06:15	73°30,1´	121°40,1´	0-7	Hydrochem.
								BG, EPN
	IK93 24			03:30	73°30,1´	121°40,1´	13	
		-1		03:40	73°30,1´	121°40,1´	13	WS
		-2		04:30	73°30,1´	121°40,1´	13	Dinghi, WS (PCB, Me.)
		-3		08:08	73°30,1´	121°40,1´	13	KG (Geo, 32 cm)
		-4		08:19	73°30,1´	121°40,1´	13	KG (Geo)
		-5		08:44	73°30,1´	121°40,1´	13	KL (Geo, 62 cm)

No.	Station #	Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
13	38	14.08.'93	18:40	74°30,2'	119°58,5'	0-30	CTD
			18:40	74°30,2'	119°58,5'	0-30	Hydrochem.
							BG, SD
	IK93 38		17:00	74°30,1'	119°58,5'	34	
	-1		17:10	74°30,1'	119°58,3'	34	WS
	-2		17:18	74°29,8'	119°58,2'	34	UWP/CTD
	-3		18:01	74°29,7'	119°58,7'	34	Bongo
	-4		18:11	74°29,6'	119°57,6'	34	KG (Geo, 34 cm)
	-5		18:36	74°29,5'	119°57,3'	34	KG (Geo, 27 cm)
	-6		18:54	74°29,4'	119°57,2'	34	KG (Bio, 30 cm)
	-7		19:12	74°29,2'	119°57,1'	34	KG (Bio, 31 cm)
	-8		19:32	74°29,1'	119°56,8'	34	KG (Geo, 33 cm)
	-9		20:50	74°28,6'	119°55,8'	34	Dredge
			to 21:18	74°28,4'	119°56,3'		
14	39	15.08.'93	00:49	73°30,3'	121°30,3'	0,25-11,00	CTD
			01:10	73°30,3'	121°30,3'	0-12	Hydrochem.
15	40	15.08.'93	04:31	73°30,0'	122°59,8'	0,25-13,25	CTD
			04:45	73°30,0'	122°59,8'	0-12	Hydrochem.
							BG, SD, EPN
	IK93 40		04:00	74°30,0'	122°59,6'	16	
	-1		04:35	74°30,0'	122°59,6'	16	WS
	-2		05:12	74°30,0'	123°02,0'	16	Dinghi, WS (PCB, Me.)
	-3		05:01	74°30,0'	122°59,6'	16	UWP/CTD
	-4		05:26	74°30,0'	122°59,6'	16	Bongo
	-5		05:40	74°30,0'	122°59,6'	16	KG (Geo,13 cm)
	-6		06:00	74°30,0'	122°59,6'	16	KG (Geo,15 cm)
	-7		06:11	74°30,0'	122°59,7'	16	KG (Bio)
	-8		06:21	74°30,0'	122°59,6'	16	KG (Bio)
	-9		06:34	74°30,0'	122°59,6'	16	KG (Geo, 29 cm)
	-10		08:53	74°30,0'	123°01,0'	16	Dredge
			to 09:03	74°29,8'	122°59,7'		
16	29	15.08.'93	13:06	74°10,2'	123°59,8'	0,25-11,75	CTD
			13:10	74°10,2'	123°59,8'	0-12	Hydrochem.
	IK93Sc-2		10:45	74°21,0'	123°30,6'		Side Scan Sonar
			to 11:45	74°17,5'	123°46,1'		
	IK93Sc-3		13:47	74°11,2'	124°03,7'		Side Scan Sonar
			to 15:04	74°15,6'	124°15,0'		
17	IK93 41	15.08.'93	17:10	73°30,1'	123°00,3'	0,25-31,75	CTD
			17:30	73°30,1'	123°00,3'	0-32	Hydrochem.
18	42	15.08.'93	21:53	74°30,0'	127°19,6'	0,25-31,25	CTD-z1
			22:15	74°30,0'	127°19,6'	0-33	Hydrochem.
							BG, SD, EPN
		16.08.'93	00:53	74°28,0'	127°21,7'	0,25-32,50	CTD-z2
			04:12	74°30,2'	127°20,0'	0,25-31,25	CTD-z3
			07:15	74°30,1'	127°24,2'	0,25-28,25	CTD-z4
	IK 93 42	15.08.'93	22:00	74°30,3'	127°19,8'	34	
	-1		22:00	74°27,4'	127°21,1'	34	WS (PCB, Me.)
	-2	16.08.'93	04:24	74°30,2'	127°19,8'	34	WS

No.	Station #	Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
	-3		05:06	74°30,4´	127°20,1´	34	Bongo
	-4		05:17	74°30,4´	127°20,2´	34	UWP/CTD
	-5		05:43	74°30,5´	127°20,6´	34	KG (Geo, 32 cm)
	-6		05:54	74°30,6´	127°20,9´	34	KG (Geo)
	-7		08:07	74°31,3´	127°27,5´	34	Dredge
			to 08:17	74°31,1´	127°27,6´	34	
19	30	16.08.´93	12:10	74°00,0´	127°30,3´	0,25-25,00	CTD-z1
			12:13	74°00,0´	127°30,3´	0,25-19,75	CTD-z2
			12:30	74°00,0´	127°30,3´	0-25	Hydrochem.
							BG, EPN
	IK 93 30		11:40	74°00,0´	127°30,0´	27	
	-1		11:44	74°00,0´	127°30,3´	27	WS
	-2		11:44	74°00,0´	127°30,3´	27	UWP/CTD
	-3		12:13	74°00,0´	127°30,3´	27	Bongo
	-4		12:24	74°00,0´	127°30,2´	27	KG (Geo, 34 cm)
	-5		12:39	74°00,0´	127°30,2´	27	KG (Geo
	-6		12:53	74°00,0´	127°30,2´	27	KG (Bio)
	-7		13:06	74°00,0´	127°30,3´	27	KG (Bio)
	-8		14:20	74°00,0´	127°30,0´	27	Dredge
			to 14:32	74°00,1´	127°29,8	27	
20	31	16.08.´93	17:38	74°00,0´	129°00,2´	0,25-13,00	CTD
			18:00	74°00,0´	129°00,2´	0-14	Hydrochem.
21	43	16.08.´93	20:47	74°29,8´	129°00,3´	0,25-35,25	CTD-z1
			20:51	74°29,8´	129°00,3´	0,25-35,25	CTD-z2
			21:30	74°29,8´	129°00,3´	0-35	Hydrochem.
22	44	17.08.´93	05:16	74°27,0´	131°05,9´	0,25-22,50	CTD
			04:40	74°27,0´	131°05,9´	0-22	Hydrochem.
							BG, SD
	IK 93 44		04:00	74°28,0´	131°05,9´	30	
	-1		04:00	74°28,0´	131°05,9´	30	WS (PCB)
	-2		04:25	74°26,5´	131°05,7´	30	WS (Me.)
	-3		06:07	74°24,9´	131°02,4´	30	WS
	-4		06:16	74°24,9´	131°02,4´	30	UWP/CTD
	-5		06:50	74°24,6´	131°01,7´	30	Bongo
	-6		07:03	74°24,4´	131°01,3´	30	KG (Geo, 27 cm)
	-7		07:14	74°24,3´	131°01,0´	30	KG (Bio, 15 cm)
	-8		07:25	74°24,3´	131°00,8´	30	KG (Geo,13 cm)
	-9		07:34	74°24,4´	131°00,6´	30	KG (Bio)
	-10		07:43	74°24,1´	131°00,3´	30	KG (Bio,18 cm)
	-11		08:49	74°23,8´	130°59,1´	30	KL (Geo, empty)
	-12		09:13	74°23,7´	130°58,7´	30	KL (Geo, empty)
	-13		09:54	74°24,5´	131°01,3´	30	Dredge
			to 10:04				
23	45	17.08.´93	13:00	74°30,0´	132°10,2´	0-15	CTD
			13:00	74°30,0´	132°10,2´	0-15	Hydrochem.
	IK 93 45		12:05	74°30,0´	132°10,1´	18	
	-1		12:20	74°29,9´	132°10,8´	18	WS
	-2		12:39	74°29,8´	132°11,2´	17	Bongo
	-3		12:49	74°29,6´	132°11,5´	17	CTD
24	46	17.08.´93	16:02	74°30,0´	134°00,5´	0,25-11,25	CTD

No.	Station #		Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
				16:30	74°30,0´	134°00,5´	0-10	Hydrochem. BG, SD,EPN
	IK 93 46			15:58	74°29,9´	134°00,7´	14	
		-1		16:00	74°29,9´	134°00,7´	14	WS
		-2		16:21	74°29,7´	134°01,2´	14	UWP/CTD
		-3		16:57	74°29,7´	134°01,9´	14	Bongo
		-4		17:10	74°29,7´	134°02,1´	14	KG (Geo, empty)
		-5		17:20	74°29,7´	134°02,3´	14	KG (Geo, 8 cm)
		-6		17:30	74°29,7´	134°02,5´	14	KG (Bio)
		-7		17:41	74°29,6´	134°02,7´	14	KG (Bio)
		-8		18:28	74°29,8´	134°03,2´	14	Dredge
				to 18:49	74°29,8´	134°01,2´		
25	47		17.08.´93	21:37	74°30,0´	135°40,1´	0,25-27,75	CTD
				22:15	74°30,0´	135°40,1´	0-30	Hydrochem.
26	48		18.08.´93	03:59	74°30,1´	137°00,8´	0,25-14,25	CTD-z1
				05:10	74°30,1´	137°00,8´	0,25-20,25	CTD-z2
				04:45	74°30,1´	137°00,8´	0-22	Hydrochem. BG, SD
	IK 93 48			04:00	74°30,0´	137°01,0´	23	
		-1		04:15	74°30,0´	137°01,0´	23	WS
		-2		04:21	74°29,8´	137°01,6´	22	UWP/CTD
		-3		04:50	74°29,3´	137°02,3´	24	Bongo
		-4		05:03	74°29,1´	137°02,4´	23	KG (Bio, 40 cm)
		-5		05:19	74°29,0´	137°02,5´	22	KG (Geo, 38cm)
		-6		05:33	74°28,8´	137°02,7´	22	KG (Geo, 33 cm)
		-7		05:46	74°28,7´	137°02,7´	21	KG (Bio, 37 cm)
		-8		06:00	74°28,5´	137°02,8´	22	KG (Geo, 30 cm)
	IK93Sc-4	-9		06:45	74°28,3´	137°02,6´		Side Scan Sonar
				to 07:11	74°30,5´	137°01,4´		
		-10		07:34			22	Dredge
				to 07:45				
27	49		18.08.´93	12:59	73°30,1´	139°40,0´	0,50-21,00	CTD-z1
				14:39	73°30,1´	139°40,0´	0,25-20,75	CTD-z2
				12:30	73°30,1´	139°40,0´	0-18	Hydrochem. BG, SD, EPN
	IK 93 49			12:13	74°30,0´	139°40,0´	24	
		-1		12:14	74°30,0´	139°40,1´	24	WS
		-2		12:26	74°30,0´	139°40,1´	24	UWP/CTD
		-3		13:06	74°30,0´	139°40,1´	24	Bongo
		-4		13:20	74°30,0´	139°40,1´	24	KG (Bio, 8,5 cm)
		-5		13:35	74°30,0´	139°40,3´	24	KG (Bio, 14 cm)
		-6		13:44	74°30,0´	139°40,2´	24	KG (Geo,14 cm)
		-7		14:02	74°30,0´	139°40,2´	24	KG (Geo,15 cm)
		-8		14:22	74°30,0´	139°40,2´	24	KG (Geo, empty)
		-9		15:26	74°29,9´	139°41,3´	24	Dredge
				to 15:36	74°29,6´	139°42,4´		
	IK93Sc-5	-10		16:02	74°28,5´	139°44,8´		Side Scan Sonar
				to 16:53	74°25,3´	139°52,3´		
	IK93Sc-6	-11		17:43	74°24,1´	139°54,3´		Side Scan Sonar
				to18:26	74°21,3´	140°02,0´		
28	49a		18.08.´93	17:04	74°25,2´	139°52,6´	0,25-16,25	CTD
				17:40	74°25,2´	139°52,6´	0-17	Hydrochem.

No.	Station #	Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
29	49b	18.08.'93	18:45	74°20,5'	140°04,3'	0,25-20,75	CTD
			19:10	74°20,5'	140°04,3'	0-20	Hydrochem.
30	34	19.08.'93	04:16	74°00,0'	137°39,8'	0,25-18,75	CTD
			04:45	74°00,0'	137°39,8'	0-18	Hydrochem.
							BG, SD, EPN
	IK 93 34		01:00	74°00,0'	137°39,8'	22	
	-1		01:00	74°00,0'	137°39,8'	22	WS (PCB)
	-2		04:13	74°00,0'	137°39,9'	22	UWP/CTD
	-3		04:13	74°00,0'	137°39,9'	22	WS
	-4		04:59	74°00,0'	137°39,8'	22	Bongo
	-5		05:10	74°00,0'	137°39,8'	22	KG (Geo, 45 cm)
	-6		05:33	74°00,0'	137°39,8'	22	KG (Geo, 42 cm)
	-7		05:46	74°00,0'	137°39,8'	22	KG (Geo, 34 cm)
	-8		06:01	74°00,0'	137°39,8'	22	KG (Bio, 40 cm)
	-9		06:15	74°00,0'	137°39,8'	22	KG (Bio, 40 cm)
	-10		06:55	73°59,9'	137°39,9'	22	KL (Geo,120/112 cm)
	-11		07:31	74°00,4'	137°39,8'	22	Dredge
			to 07:43	74°00,5'	137°39,9'		
31	33	19.08.'93	13:06	74°00,1'	135°10,3'	0,75-20,50	CTD
			13:20	74°00,1'	135°10,3'	0-20	Hydrochem.
32	32	19.08.'93	15:39	74°00,2'	133°59,6'	0,25-10,75	CTD
			16:00	74°00,2'	133°59,6'	0-10	Hydrochem.
33	31a	19.08.'93	20:01	73°59,7'	132°09,4'	0,25-11,00	CTD
			20:15	73°59,7'	132°09,4'	0-10	Hydrochem.
34	23	20.08.'93	04:31	73°38,1'	128°39,9'	0,25-14,50	CTD-z1
			04:36	73°38,1'	128°39,9'	0,50-14,25	CTD-z2
			05:15	73°38,1'	128°39,9'	0-15	Hydrochem.
							BG, SD
	IK93 23	20.08.'93	04:00	73°38,0'	128°39,8'	17	
	-1		4:28 to 7:35	73°34,0'	128°44,0'	17	Dinghi, WS (PCB, Me.)
	-2		05:00	73°37,8'	128°39,1'	17	UWP
	-3		05:27	73°37,8'	128°39,1'	17	Bongo
	-4		05:39	73°37,8'	139°39,2'	17	KG (Bio, 27 cm)
	-5		05:52	73°37,8'	139°39,2'	17	KG (Geo, 29 cm)
	-6		06:02	73°37,8'	139°39,2'	17	KG (Geo, 25 cm)
	-7		06:16	73°37,8'	139°39,2'	17	KG (Bio, 25 cm)
	-8		08:10	73°39,8'	128°36,9'	19	WS
	-9		08:54	73°37,9'	128°39,2'	17	Dredge
			to 9:04	73°37,7'	128°39,3'		
35	22	20.08.'93	11:41	73°30,7'	130°01,4'	0,25-14,50	CTD
			11:50	73°30,7'	130°01,4'	0-15	Hydrochem.
36	21	20.08.'93	14:56	73°30,0'	131°40,1'	0,25-20,50	CTD
			15:10	73°30,0'	131°40,1'	0-20	Hydrochem.
							BG, SD, EPN
	IK93 21		14:47	73°30,0'	131°40,4'	25	
	-1		15:00	73°29,9'	131°40,4'	25	WS
	-2		15:07	73°29,7'	131°39,8'	25	UWP
	-3		15:40	73°29,3'	131°39,2'	25	Bongo

No.	Station #	Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
	-4		16:12	73°28,9´	131°39,0´	25	KG (Geo, 45 cm)
	-5		16:27	73°28,7´	131°38,9´	25	KG (Geo, 44 cm)
	-6		16:39	73°28,5´	131°38,7´	24	KG (Bio, 42 cm)
	-7		16:52	73°28,4´	131°38,7´	24	KG (Bio, 44 cm)
	-8		17:20	73°27,9´	131°38,6´	24	KL (Geo,120/112 cm)
	-9		18:58	73°29,9´	131°39,9´		Dredge
			to 19:08	73°30,3´	131°40,0´		
37	20	21.08.´93	05:13	73°30,0´	133°30,6´	0,25-14,25	CTD
			05:30	73°30,0´	133°30,6´	0-15	Hydrochem.
							BG, SD, EPN
	IK93 20		05:00	73°30,0´	133°30,0´	18	
	-1		05:19	73°29,7´	131°31,2´	18	KG (Geo, 9 cm)
	-2		05:30	73°29,0´	133°31,5´	18	KG (Geo, 14 cm)
38		21.08.´93	09:59	73°30,0´	135°20,1´	0,25-24,25	CTD-z1
			10:02	73°30,0´	135°20,1´	0,25-24,00	CTD-z2
			10:30	73°30,0´	135°20,1´	0-25	Hydrochem.
39	18	21.08.´93	14:11	73°30,1´	137°30,1´	0,25-20,25	CTD
			14:30	73°30,1´	137°30,1´	0-19	Hydrochem.
	IK93 18		14:01	73°30,0´	137°30,0´	24	
	-1		14:18	73°30,0´	137°30,9´	24	KG (Geo, 30 cm)
	-2		14:23	73°30,0´	137°31,1´	24	WS
	-3		14:31	73°29,9´	137°31,4´	24	KG (overpenetrated)
	-4		14:42	73°29,9´	137°32,1´	24	KG (overpenetrated)
	-5		14:57	73°29,8´	137°33,1´	24	KG (Geo, 45 cm)
	-6		14:56	73°29,7´	137°33,1´	24	WS
	-7		15:29	73°29,6´	137°34,9´	24	KL (Geo,150/ 0 cm)
	-8		17:15	73°28,9´	137°41,0´	10	WP (PCB)
			to 20:00	73°27,9´	137°54,7´		
40	17	21.08.´93	21:38	73°29,7´	138°41,6´	0,25-12,25	CTD
41	12a	22.08.´93	01:23	73°15,6´	140°21,0´	0,50-11,00	CTD
			01:45	73°15,6´	140°21,0´	0-9	Hydrochem.
42	12b	22.08.´93	02:59	73°07,4´	140°30,6´	0,25-12,50	CTD-z1
			03:02	73°07,4´	140°30,6´	0,25-12,50	CTD-z2
			03:10	73°07,4´	140°30,6´	0-15	Hydrochem.
43	12c	22.08.´93	05:08	72°57,2´	140°40,8´	0,50-07,75	CTD-z1
			05:10	72°57,2´	140°40,8´	0,25-10,75	CTD-z2
			05:23	72°57,2´	140°40,8´	0,25-10,75	CTD-z3
			05:35	72°57,2´	140°40,8´	0-10	Hydrochem.
44	12	22.08.´93	10:42	72°45,3´	139°08,9´	0,25-13,75	CTD
			10:50	72°45,3´	139°08,9´	0-14	Hydrochem.
45	13	22.08.´93	13:55	73°03,1´	139°21,9´	0,50-13,00	CTD
			14:00	73°03,1´	139°21,9´	0-12	Hydrochem.
	IK93 13		13:45	73°04,0´	139°22,2´	16	
	-1		13:52	73°03,9´	139°22,2´	16	WS
	-2		14:48	73°03,3´	139°24,0´	16	UWP
	-3		15:15	73°03,7´	139°24,0´	16	Bongo
	-4		15:25	73°03,8´	139°24,0´	16	KG (Bio, 5 cm)

No.	Station #		Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
		-5		15:36	73°04,0´	139°25,3´	16	KG (Bio, 9 cm)
		-6		15:48	73°04,2´	139°25,6´	16	KG (Geo, 9 cm)
		-7		15:58	73°04,3´	139°25,8´	16	KG (Geo,18 cm)
		-8		16:05	73°04,4´	139°26,1´	16	KG (Geo)
		-9		16:56	73°03,8´	139°24,2´	16	Dredge
				to 17:06	73°03,5´	139°25,3´		
46	14		23.08.´93	04:23	73°00,3´	135°59,7´	0,25-19,50	CTD
				04:45	73°00,3´	135°59,7´	0-17	Hydrochem.
47	15		23.08.´93	09:36	72°60,0´	133°29,9´	0,25-15,00	CTD
				10:10	72°60,0´	133°29,9´	0-14	Hydrochem.
								BG, SD, EPN
	IK93 15			09:28	73°00,0´	133°29,9´	18	
		-1		09:36	73°00,0´	133°28,3´	18	KG (Geo, 32 cm)
		-2		09:46	73°00,2´	133°28,0´	18	KG (Geo, 38 cm)
		-3		10:17	73°00,2´	133°28,0´	18	KL (Geo, 22 cm)
		-4		10:33	73°00,3´	133°27,9´	18	KL (Geo, 36 cm)
48	16		23.08.´93	15:02	73°00,0´	131°30,2´	0,50-23,75	CTD
				15:30	73°00,0´	131°30,2´	0-24	Hydrochem.
								BG, SD
	IK 93 16			14:52	73°00,1´	131°30,0´	28	
		-1		14:55	73°00,1´	131°30,2´	28	WS (Me.)
		-2			73°00,1´	131°30,2´	28	WS
		-3		15:05	73°00,1´	131°30,2´	28	UWP
		-4		15:58	73°00,1´	131°30,1´	28	Bongo
		-5		16:25	73°00,1´	131°30,1´	28	KG (Bio, 40 cm)
		-6		16:40	73°00,1´	131°30,1´	28	KG (Geo, 38 cm)
		-7		16:52	73°00,1´	131°30,1´	28	KG (Geo, 40)
		-8		17:08	73°00,1´	131°30,1´	28	KG (Bio, 38 cm)
		-9		17:36	73°00,1´	131°30,1´	28	KL (Geo, 64/54 cm)
		-10		18:33	73°00,2´	131°30,6´	28	Dredge
				to 18:43	73°00,3´	131°31,3´		
49	Z-4		24.08.´93	02:15	72°01,6´	130°07,6´	0,25-11,75	CTD
				02:30	72°01,6´	130°07,6´	0-12	Hydrochem.
								BG, SD, EPN
	IK93 Z4			03:54	72°02,0´	130°07,6´	14	
		-1		04:10	72°02,0´	130°07,6´	14	WS
		-2		05:24	72°01,0´	130°07,0´	14	Dinghi, WS (PCB,Me.)
		-3		04:20	72°02,0´	130°07,6´	14	KG (Geo, 33 cm)
		-4		04:40	72°02,0´	130°07,6´	14	KG (Geo, 34 cm)
		-5		05:10	72°02,0´	130°07,5´	14	KL (Geo, 50 cm)
		-6		08:04	72°02,0´	130°07,6´	14	WP (PCB)
50	6		27.08.´93	16:16	72°00,2´	130°59,8´	0,25-14,75	CTD
				16:20	72°00,2´	130°59,8´	0-15	Hydrochem.
	IK93 06			15:19	72°00,1´	131°00,0´	18	
		-1		15:20	72°00,1´	131°00,0´	18	WS (Metalle)
		-2		15:51	72°00,2´	130°59,7´	18	WS
		-3		16:00	72°00,2´	130°59,6´	18	UWP
		-4		16:50	72°00,5´	130°59,3´	18	Bongo
		-5		17:04	72°00,6´	130°59,2´	18	KG (Geo, 37cm)
		-6		17:18	72°00,7´	130°59,2´	18	KG (Geo, 31 cm)

No.	Station #	Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
	-7		17:31	72°00,8´	130°59,2´	18	KG (Bio, overpene.)
	-8		17:46	72°00,9´	130°59,2´	18	KG (Bio, 35 cm)
	-9		18:01	72°00,9´	130°59,3´	18	KG (Bio, 35 cm)
	-10		18:13	72°01,0´	130°59,4´	18	KG (Geo, 41 cm)
	-11		18:54	72°01,2´	130°59,9´	18	KL (70 cm)
	-12		20:06	72°00,1´	130°59,2´	18	Dredge
			to 20:16	72°00,1´	130°59,2´	18	
	-13		21:00	72°01,8´	130°59,8´	18	WP (PCB)
51	5	28.08.´93	04:12	71°60,0´	133°00,1´	0,25-09,75	CTD
			04:30	71°60,0´	133°00,1´	0-10	Hydrochem.
							BG, SD, EPN
52	4	28.08.´93	15:52	71°59,9´	134°59,1´	0,25-15,50	CTD
			16:15	71°59,9´	134°59,1´	0-15	Hydrochem.
53	3	28.08.´93	21:06	71°60,0´	137°00,0´	0,25-10,75	CTD
			21:25	71°60,0´	137°00,0´	0-10	Hydrochem.
54	2	28.08.´93	23:46	71°60,0´	138°00,3´	0,75-15,75	CTD
		29.08.´93	00:15	71°60,0´	138°00,3´	0-15	Hydrochem.
55	Z-5	29.08.´93	04:19	71°41,4´	137°00,4´	0,25-09,25	CTD
			04:25	71°41,4´	137°00,4´	0-9	Hydrochem.
							BG, SD, EPN
	IK93 Z5		03:16	71°41,4´	137°00,3´	11	
	-1		03:45	71°41,4´	137°00,4´	11	WP (PCB)
	-2		09:57	71°41,4´	137°00,4´	11	WS (Me.)
	-3		10:11	71°41,4´	137°00,4´	11	KG (Geo, 21 cm)
	-4		10:22	71°41,4´	137°00,4´	11	KG (Geo, 30/23 cm)
	-5		10:31	71°41,4´	137°00,4´	11	KG (Geo, 22 cm)
56	1	29.08.´93	14:24	71°45,2´	135°39,6´	0,25-13,50	CTD
			14:30	71°45,2´	135°39,6´	0-13	Hydrochem.
							BG, SD
	IK93 01		13:54	71°45,2´	135°39,6´	16	
	-1		14:03	71°45,2´	135°39,6´	16	WS
	-2		14:20	71°45,2´	135°39,6´	16	UWP
	-3		14:44	71°45,2´	135°39,6´	16	Bongo
	-4		15:04	71°45,2´	135°39,6´	16	KG (Bio, 23 cm)
	-5		15:16	71°45,2´	135°39,6´	16	KG (Geo, 23/18 cm)
	-6		15:25	71°45,2´	135°39,6´	16	KG (Geo, 21 cm)
	-7		15:34	71°45,2´	135°39,6´	16	KG (Bio, 25 cm)
	-8		16:12	71°45,0´	135°40,1´	16	Dredge
			to 16:29	71°45,0´	135°40,9´		
57	11	29.08.´93	23:18	72°29,9´	138°00,6´	0,25-15,75	CTD
			23:30	72°29,9´	138°00,6´	0-15	Hydrochem.
58	9	30.08.´93	04:11	72°30,0´	136°37,4´	0,25-21,00	CTD
			04:30	72°30,0´	136°37,4´	0-20	Hydrochem.
							BG, SD, EPN
	IK93 09		03:00	72°30,0´	136°40,0´	24	
	-1		03:30	72°30,0´	136°40,0´	24	WP (PCB)
	-2		06:25	72°29,5´	136°35,4´	24	KG (Geo, 40/32 cm)
	-3		06:38	72°29,5´	136°35,4´	24	KG (Geo, overpene.)

No.	Station #		Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
		-4		06:55	72°29,4′	136°35,2′	24	KG (Geo, 37 cm)
		-5		07:19	72°29,2′	136°35,0′	24	SL (Geo,158/136 cm)
		-6		08:00	72°29,1′	136°34,9′	23	KL (Geo, 158/148 cm)
		-7		08:34	72°29,5′	136°34,8′	24	WS (Me.)
59	10		30.08.′93	11:51	72°30,0′	134°40,2′	0,25-20,25	CTD
				12:00	72°30,0′	134°40,2′	0-20	Hydrochem.
60	8		30.08.′93	15:16	72°29,9′	132°59,8′	0,50-19,75	CTD
				15:25	72°29,9′	132°59,8′	0-20	Hydrochem.
61	7		31.08.′93	05:00	72°30,0′	131°18,3′	0,25-18,25	CTD
				05:15	72°30,0′	131°18,3′	0-18	Hydrochem.
	IK93 07			02:30	72°33,1′	131°17,6′	21	
		-1		03:00	72°32,0′	131°17,6′	20	WP (PCB)
		-2		06:05	72°32,8′	131°14,9′	21	WS (Me.)
		-3		06:52	72°33,0′	131°17,8′	21	KG (Geo, 28 cm)
62	81		01.09.′93	10:27	76°31,5′	133°19,2′	0,50-34,50	CTD
				10:45	76°31,5′	133°19,2′	0-34	Hydrochem.
								BG, SD, EPN
	IK93 81			09:17	76°31,6′	133°18,6′	37	
		-1		09:17	76°31,6′	133°18,8′	37	WS (Bio)
		-2		09:17	76°31,6′	133°18,8′	37	UWP
		-3		10:06	76°31,6′	133°18,7′	38	KG (Geo, 45/35 cm)
63	73a		01.09.′93	19:59	75°50,0′	134°29,5′	0,50-41,75	CTD-z1
			02.09.′93	04:34	75°48,4′	134°38,0′	0,50-40,25	CTD-z2
				05:30	75°48,4′	134°38,0′	0-40	Hydrochem.
								BG, SD
	IK93 73A			01:45	75°51,1′	134°32,1′	47	
		-1		01:45	75°51,1′	134°32,1′	47	WS (Bio)
		-2		02:24	75°50,6′	134°33,4′	47	UWP
		-3		03:04	75°49,9′	134°34,4′	46	Multinet
		-4		03:20	75°49,5′	134°34,8′	46	Bongo
		-5		03:55	75°48,9′	134°35,1′	46	KG (Bio, 32 cm)
		-6		04:08	75°48,6′	134°35,0′	46	KG (Geo, 31 cm)
		-7		04:22	75°48,4′	134°34,9′	46	KG (Bio)
		-8		06:29	75°48,9′	134°34,9′	43	Dredge
				to 06:39	75°48,9′	134°23,9′		
64	82		02.09.′93	19:49	76°30,0′	137°19,6′	0,25-21,00	CTD
				20:00	76°30,0′	137°19,6′	0-22	Hydrochem.
								BG, SD, EPN
	IK93 82			18:51	76°29,9′	137°19,7′	25	
		-1		18:55	76°30,0′	137°19,4′	25	WS
		-2		19:17	76°30,0′	137°18,8′	25	UWP
		-3		19:31	76°30,0′	137°18,5′	25	Bongo
		-4		19:40	76°30,1′	137°18,0′	25	KG (Geo, 35 cm)
		-5		20:03	76°30,1′	137°16,9′	25	KG (Bio, 16 cm)
		-6		20:18	76°30,2′	137°16,3′	25	KG (Geo)
		-7		20:39	76°30,3′	137°15,4′	25	KG (Geo, 23 cm)
		-8		21:42	76°30,0′	137°20,4′	24	Dredge
				to 21:52	76°29,8′	137°21,4′		

No.	Station #	Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
65	74	03.09.'93	05:23	75°20,9'	136°34,9'	0,25-18,50	CTD-z1
			05:38	75°20,9'	136°34,9'	0,25-18,50	CTD-z2
			05:30	75°20,9'	136°34,9'	0-19	Hydrochem.
66	50	03.09.'93	07:52	74°59,9'	135°60,0'	0,50-27,00	CTD
			08:20	74°59,9'	135°60,0'	0-25	Hydrochem.
							BG, SD, EPN
	IK93 50		07:45	75°00,0'	136°00,0'	31	
	-1		08:15	75°00,1'	136°59,5'	31	WS
	-2		08:32	75°00,2'	135°68,8'	31	Dinghi (PCB, Me.)
	-3		08:45	75°00,2'	135°58,8'	31	UWP
	-4		09:18	75°00,5'	136°00,9'	30	Multinet
	-5		09:32	75°00,5'	136°00,9'	30	Bongo
	-6		09:45	75°00,6'	136°01,8'	31	KG (Geo, 34 cm)
	-7		10:01	75°00,8'	136°01,7'	30	KG (Geo, 42 cm)
	-8		10:23	75°01,1'	136°01,8'	30	KG (Bio, 44 cm)
	-9		10:38	75°01,3'	136°01,9'	30	KG (Bio, 44 cm)
	-10		11:14	75°01,8'	136°02,0'	29	KL (empty)
	-11		12:07	75°00,0'	135^°58,9'	31	Dredge
			to 12:17	74°59,7'	136°00,1'		
67	51	03.09.'93	15:58	75°00,1'	133°59,8'	0,25-18,25	CTD
			16:15	75°00,1'	133°59,8'	0-18	Hydrochem.
68	52	03.09.'93	19:54	75°00,1'	131°59,1'	0,75-14,25	CTD
			20:05	75°00,1'	131°59,1'	0-14	Hydrochem.
69	53	04.09.'93	06:07	75°00,0'	129°58,6'	0,75-37,75	CTD
			06:45	75°00,0'	129°58,6'	0-37	Hydrochem.
							BG, SD
	IK93 53		00:00	75°00,0'	129°57,3'	40	
	-1		00:00	75°00,0'	129°57,3'	40	WP (PCB)
	-2		07:00	75°00,0'	129°54,5'	40	WP (PCB)
	-3		12:17	74°58,9'	129°46,6'	40	UWP
	-4		12;44	74°58,5'	129°46,4'	40	Multinet
	-5		13:02	74°58,3'	129°46,4'	40	Bongo
	-6		12:57	74°58,3'	129°46,4'	40	WS
	-7		13:14	74°58,2'	129°46,4'	40	Bongo
	-8		13:48	74°57,7'	129°46,7'	40	KG (Geo, 34 cm)
	-9		14:03	74°57,6'	129°45,9'	40	KG (Geo, 33 cm)
	-10		14:19	74°57,4'	129°45,8'	40	KG (Bio, 37 cm)
	-11		14:32	74°57,3'	129°45,8'	40	KG (Bio,35 cm)
	-12		15:04	74°57,0'	129°45,5'	40	KL (Geo, 0/0 cm)
	-13		16:09	74°58,7'	129°46,6'	40	Dredge
			to 16:20				
	-14		16:35	74°59,5'	129°44,6'	40	WS (Me.)
70	54	04.09.'93	20:17	75°00,1'	129°29,6'	0,50-34,75	CTD
			21:00	75°00,1'	129°29,6'	0-35	Hydrochem.
71	55	05.09.'93	01:06	75°00,2'	125°01,0'	0,50-35,75	CTD
			01:20	75°00,2'	125°01,0'	0-37	Hydrochem.
72	56	05.09.'93	05:05	75°00,1'	122°59,7'	0,25-29,75	CTD
			05:45	75°00,1'	122°59,7'	0-29	Hydrochem.
							BG, SD, EPN

No.	Station #	Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
	IK93 56		05:00	75°00,0´	123°00,0´	32	
	-1		05:10	74°59,8´	123°00,6´	32	KG (Geo, 21 cm)
	-2		05:20	74°59,8´	123°00,9´	33	KG (Geo, 15 cm)
73	57	05.09.´93	11:05	74°59,9´	121°19,9´	0,25-23,75	CTD
			11:20	74°59,9´	121°19,9´	0-24	Hydrochem.
74	58	05.09.´93	14:03	75°00,2´	119°50,8´	0,25-30,00	CTD
			14:20	75°00,2´	119°50,8´	0-30	Hydrochem.
							BG, SD
	IK93 58		13:45	75°00,0´	119°50,0´	33	
	-1		14:00	75°00,3´	119°50,9´	33	WS (Bio)
	-2		14:06	75°00,4´	119°51,1´	33	UWP
	-3		14:32	75°00,7´	119°52,7´	33	Multinet
	-4		14:46	75°00,8´	119°52,7´	34	Bongo
	-5		15:02	75°01,0´	119°53,3´	34	KG (Geo,35 cm)
	-6		15:10	75°01,6´	119°53,8´	34	KG (Geo, 38 cm)
	-7		15:23	75°01,1´	119°54,4´	34	KG (Bio)
	-8		15:34	75°01,2´	119°55,0´	34	KG (Bio)
	-9		16:35	75°01,6´	119°57,0´	34	KL (Geo, 0 cm)
	-10		16:50	75°01,6´	119°57,3´	34	KL (Geo, 40 cm)
	-11		17:05	75°01,7´	119°57,4´	34	UWP
	-11		17:18	75°04,7´	119°57,5´	34	UWP
	-12		17:47			34	UWP
			to 17:59				
75	59	05.09.´93	21:55	74°60,0´	117°29,9´	0,25-27,75	CTD
			22:30	74°60,0´	117°29,9´	0-28	Hydrochem.
76	60	06.09.´93	04:17	75°00,4´	116°06,7´	0,25-19,50	CTD
			04:30	75°00,4´	116°06,7´	0-19	Hydrochem.
	IK93 60		00:30	75°00,3´	116°00,2´	24	
	-1		01:00	74°58,3´	116°07,6´	24	WP (PCB)
77	65	06.09.´93	14:47	75°29,0´	119°54,0´	0,25-38,25	CTD
			15:20	75°29,0´	119°54,0´	0-39	Hydrochem.
							BG, SD, EPN
	IK 93 65		14:30	75°29,0´	119°54,0´	40	
	-1		14:32	75°29,0´	119°54,7´	40	WS
	-2		15:11	75°28,9´	119°54,1´	43	UWP
	-3		16:27	75°28,3´	119°57,2´	44	Multinetz
	-4		16:44	75°28,3´	119°57,4´	43	Bongo
	-5		16:51	75°28,2´	119°57,6´	43	Bongo
	-6		17:05	75°28,1´	119°57,7´	43	KG (Geo, 27 cm)
	-7		17:18	75°28,0´	119°57,0´	43	KG (Bio)
	-8		17:29	75°27,9´	119°58,0´	43	KG (Geo, 26 cm)
	-9		17:42	75°27,9´	119°59,2´	43	KG (Bio)
	-10		18:07	75°27,7´	119°58,5´	43	SL (Geo, 20 cm)
	-11		18:52	75°28,2´	119°54,9´	44	Dredge
			to 19:02	75°29,1´	119°54,7´		
78	66	06.09.´93	22:41	75°30,1´	121°57,0´	0,25-46,25	CTD
			23:15	75°30,1´	121°57,0´	0-50	Hydrochem.
79	67	07.09.´93	03:56	75°28,8´	123°50,1´	0,25-39,50	CTD
			04:10	75°28,8´	123°50,1´	0-40	Hydrochem.

No.	Station #	Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
							BG, SD
	IK93 67		02:20	75°29,0´	123°50,5´	44	
	-1		02:44	75°28,9´	123°50,5´	44	KG (Geo, 35 cm)
	-2		02:57	75°28,9´	123°50,5´	44	KG (Geo, 31 cm)
80	68	07.09.´93	08:02	75°25,1´	125°51,7´	0,25-38,25	CTD
			08:30	75°25,1´	125°51,7´	0-38	Hydrochem.
							BG, SD
	IK93 68		08:00	75°25,0´	125°51,0´	41	
	-1		08:05	75°25,1´	125°51,7´	41	WS (Bio)
	-2		08:25	75°25,2´	125°51,4´	41	UWP
	-3		08:59	75°25,3´	125°50,7´	41	Multinet
	-4		09:09	75°25,3´	125°50,7´	41	Bongo
	-5		09:19	75°25,4´	125°50,4´	41	Bongo
	-6		09:32	75°25,4´	125°50,2´	41	KG (Geo, 24 cm)
	-7		09:46	75°25,4´	125°50,1´	41	KG (Bio, 28 cm)
	-8		09:57	75°25,5´	125°49,8´	41	KG (Geo, 31 cm)
	-9		10:12	75°25,6´	125°49,7´	41	KG (Bio, 32 cm)
	-10		10:43	75°25,7´	125°49,5´	41	SL (Geo, 20 cm)
	-11		11:13	75°24,9´	125°52,6´	41	Dredge
			to 11:23	75°24,9´	125°23,1´		
81	69	07.09.´93	14:32	75°25,0´	127°47,8´	0,25-40,00	CTD
			15:00	75°25,0´	127°47,8´	0-40	Hydrochem.
82	70	07.09.´93	18:26	75°23,9´	129°48,5´	0,25-30,75	CTD-z1
			18:31	75°23,9´	129°48,5´	0,25-43,50	CTD-z2
			19:03	75°23,9´	129°48,5´	0,25-42,25	CTD-z3
			19:00	75°23,9´	129°48,5´	0-43	Hydrochem.
							BG, SD
	IG93 70		18:00	75°18,0´	129^34,0´	44	
	-1		18:30	75°18,8´	129^34,1´	44	WP (PCB)
	-2		02:45	75°18,6´	129^33,4´	44	WS (Bio)
	-3		02:45	75°18,6´	129^33,4´	44	UWP
	-4		03:26	75°18,0´	129^31,9´	44	Multinet
	-5		03:42	75°17,8´	129^31,2´	44	Bongo
	-6		04:43	75°17,0´	129^28,6´	44	KG (Geo, 39 cm)
	-7		05:02	75°16,2´	129^27,9´	44	KG (Geo, 35 cm)
	-8		05:15	75°16,6´	129^26,6´	44	KG (Bio,35 cm)
	-9		05:29	75°16,4´	129^26,6´	44	KG (Bio, 35 cm)
	-10		06:21	75°18,3´	129^32,6´	44	Dredge
			to 06:31	75°18,6´	129^33,7´	44	
	-11		06:39	75°18,8´	129^34,0´	44	WS (Me.)
83	IK93 Sc-10		09:01	75°25,1´	130°36,2´		Sidescan
			to 11:31	75°24,4´	131°17,8´		
84	71	08.09.´93	12:58	75°23,0´	131°48,4´	0,50-17,25	CTD
			13:05	75°23,0´	131°48,4´	0-17	Hydrochem.
							BG
	IK93 71		12:46	75°23,0´	131°48,2´	20	
	-1		12:50	75°23,0´	131°48,2´	20	KG (Geo, 16 cm)
	-2		12:59	75°23,0´	131°48,1´	20	KG (overpenetrated)
	-3			75°23,0´	131°47,9´	20	KG (Geo, 15 cm)

No.	Station #		Date	Time (GMT)	Latitude (° N)	Longitude (° E)	Depth (m)	Activity
85	72		08.09.'93	17:55	75°22,0'	133°46,1'	0,25-24,50	CTD
				18:10	75°22,0'	133°46,1'	0-25	Hydrochem.
86	73		09.09.'93	03:06	75°21,0'	135°06,3'	0,25-41,00	CTD
				04:45	75°21,0'	135°06,3'	0-40	Hydrochem.
								BG, SD
	IK93 73			02:30	75°21,0'	135°22,0'	43	
		-1		06:25	75°21,2'	135°05,7'	43	UWP
		-2		06:25	75°21,2'	135°05,6'	43	WS (Bio)
		-3		07:10	75°20,5'	135°10,0'	43	Multinet
		-4		07:25				Bongo
		-5		07:35				Bongo
		-6		04:15	75°20,6'	135°08,8'	47	KG (Bio, 30 cm)
		-7		04:25	75°20,6'	135°09,3'	47	KG (Geo, 28 cm)
		-8		04:37	75°20,5'	135°10,0'	43	KG (Geo, 34 cm)
		-9		04:55	75°20,5'	135°11,0'	43	KG (Bio, 38 cm)
		-10		05:27	75°20,8'	135°12,3'	47	KL (Geo, 129 cm)
		-11		06:15	75°21,1'	135°06,3'	43	Dredge
				to 06:25	75°21,4'	135°05,5'		
87	74		09.09.'93	09:40	75°21,0'	136°33,4'	0,25-18,25	CTD
				10:00	75°21,0'	136°33,4'	0-18	Hydrochem.
88	IK93 K-1		09.09.'93	13:55	75°56,1'	136°41,7'	0,25-17,75	CTD
				13:35	75°56,0'	136°42,0'	20	
		-1		13:49	75°56,4'	136°42,5'	20	KG (Geo, 12 cm)
		-2		14:27	75°56,8'	136°44,8'	19	Mooring
89	IK93 82A		10.09.'93	12:40	76°30,0'	137°20,0'	25	
		-1		12:46	76°30,1'	137°20,3'	25	Mooring
90	IK93 K-2	-1	13.09.'93	16:18	76°50,1'	137°17,7'	30	KG
		-2			76°49,7'	137°17,9'	29	Mooring
91	IK93 84	-1	13.09.'93	00:56	77°06,7'	137°13,5'	33	KG (Geo, 33cm)
92	IK93 80	-1	14.09.'93	05:18	76°31,3'	129°50,6'	62	WS (Me.)
				06:15	76°30,3'	129°53,2'	63	WP

List of used abbreviations in the station list of TRANSDRIFT I

BG	Grab sampler
CTD	Conductivity, temperature, depth probe
KG	Spade box corer
KL	Gravity kasten corer
SD	Sigsby dredge
UWP	Under-water camera
WP (PCB)	Water pumping system for sampling of polychlorinated Biphenyls
WS	Water sampler
EPN	Epibenthic plancton net

Tab. A3: Description of sediment cores taken during the TRANSDRIFT I expedition

Symbols used in graphical core descriptions

Lithology

- sand
- sandy silt
- sandy clay
- sandy silt clay
- silt
- silty clay
- clay
- foraminiferal ooze
- nannofossil ooze
- diatomaceous ooze
- volcanic ash
- chert / porcellanite
- pebbles, dropstones
- sediment clasts

Structure

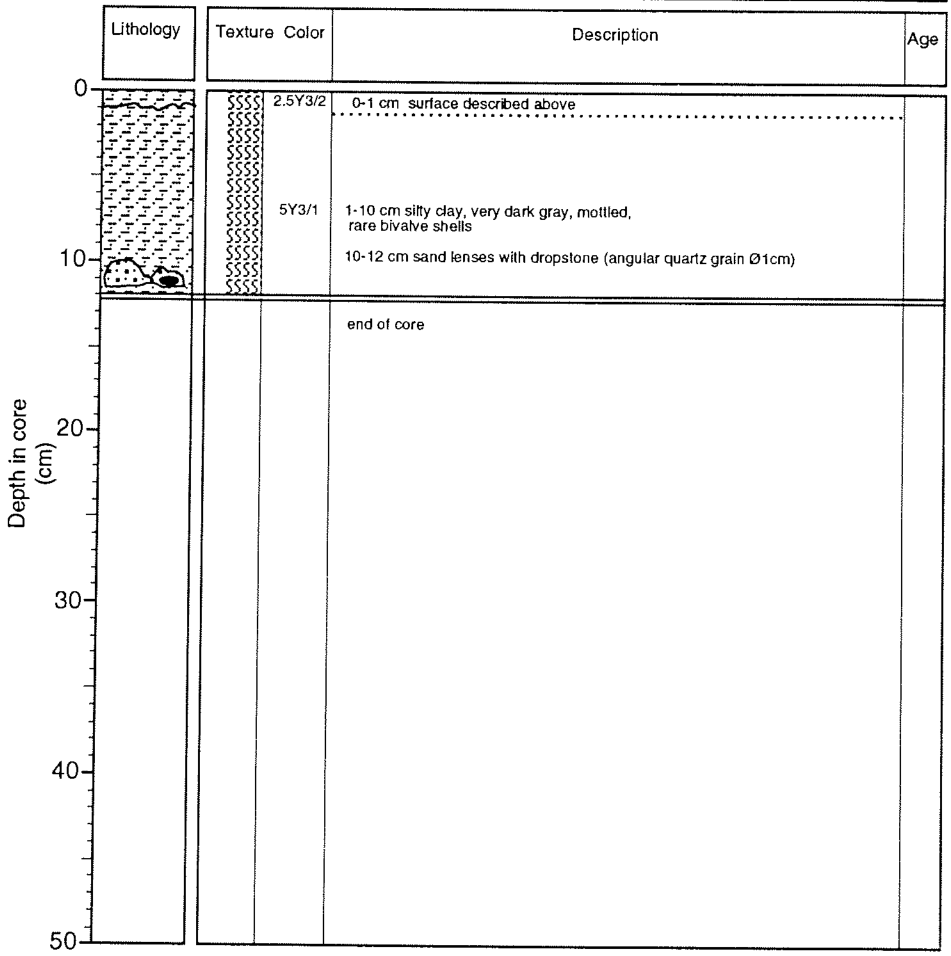
- bioturbation
- Δ fining upwards
- ∇ coarsening upwards
- — sharp boundary
- = stratification
- ≡ lamination
- .... gradational boundary
- e smear slide

IKKIREYEV1-1 (KG) Loc.: Saria Graben **TRANSDRIFT I**

Recovery: 0.12 m 75°56.36´ N, 136°42.54´ E Water depth:20 m

T=-0.4°C

Surface silty clay, very dark greyish brown (2.5Y3/2), mottled, rare bivalve

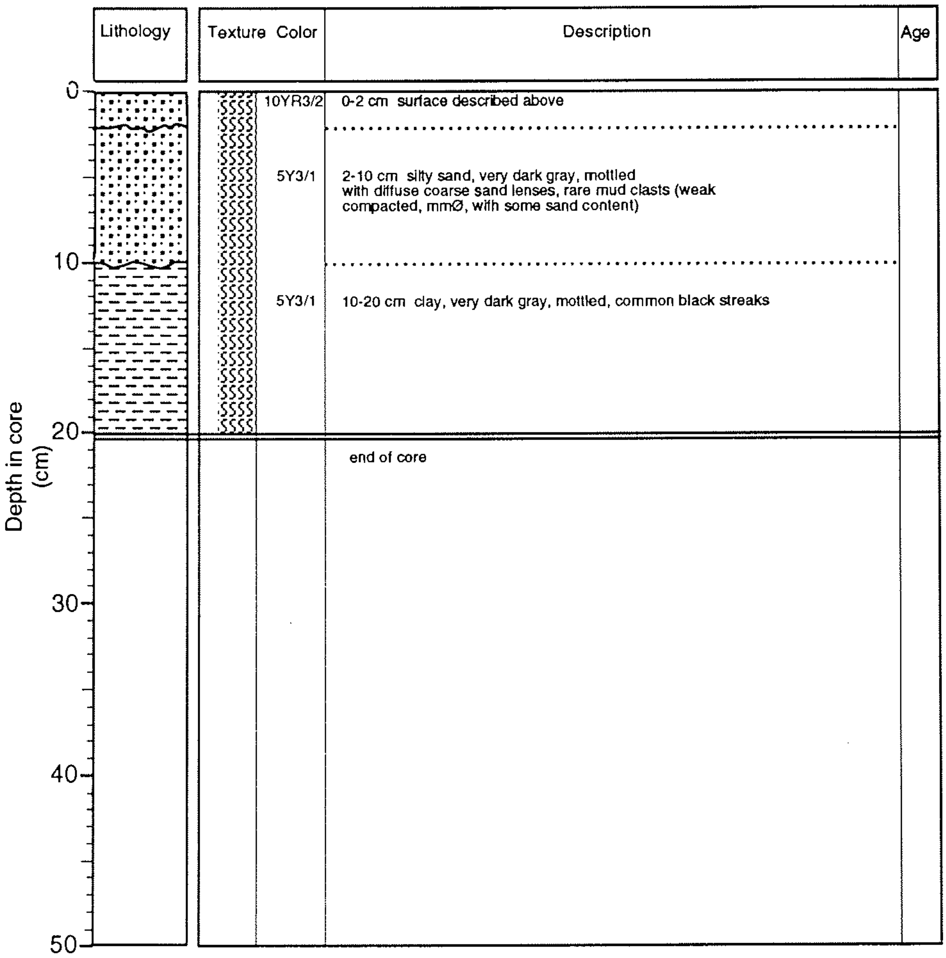


IK93KIREYEV2-1 (KG) Loc.: North of Kotelnyy **TRANSDRIFT I**

Recovery: 0.20 m 76°50.10´ N, 137°17.63´ E Water depth: 30.1 m

T=-1.6°C

Surface silty sand, very dark greyish brown (10YR3/2), soft, mottled, common brittle stars, rare worm tubes

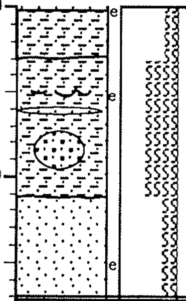


IK93Z2-5 (KG) Loc.: Anabar mouth **TRANSDRIFT I**

Recovery: 0.17 m 73°90.01´ N, 113°59.79´ E Water depth: 9 m

T=+0.7°C

Surface sandy silt, olive brown (2.5Y4/4), soft, smooth, irregular surface, common traces worms, amphipods



Lithology	Texture	Color	Description	Age
		2.5Y4/4	0-3 cm silty mud, olive brown, bioturbated	
		5Y4/3	3-11 cm muddy silt, olive grey, gradual lightening upwards, mottled, bioturbated bivalves shell fragments at 5 cm very dark grey (5Y3/1) horizont at 6-7 cm, sandy lense at 8 cm (2x5 cm)	
		2.5Y3/0	11-17 cm silt, very dark grey, mottled T=-1.7°C	
			end of core	

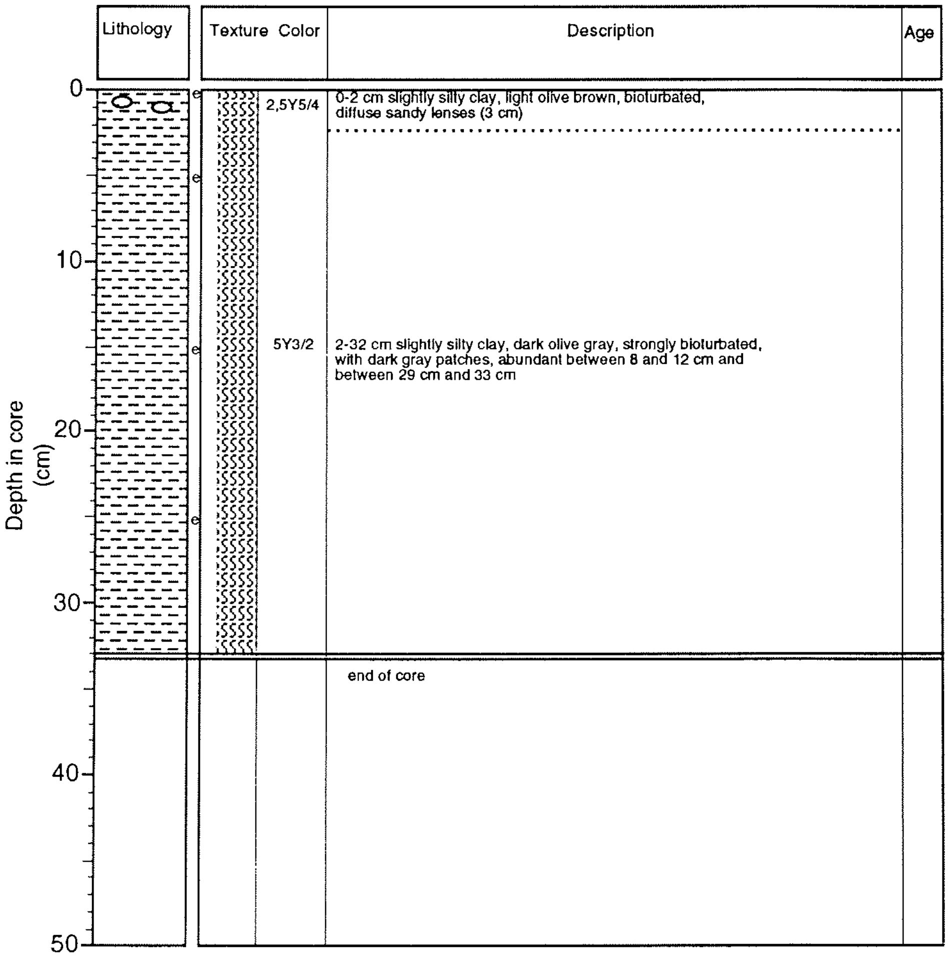
Depth in core (cm): 0, 10, 20, 30, 40, 50

IK93Z3-4 (KG) Loc.: Olenek mouth **TRANSDRIFT I**

Recovery: 0.33 m 73°17.51´ N, 119°49.90´ E Water depth: 11 m

T= -1.8°C

Surface slightly silty clay, dark yellowish brown, soft, mottled, bioturbated common bivalves and fossil bivalve shells, worm tubes, trace marks

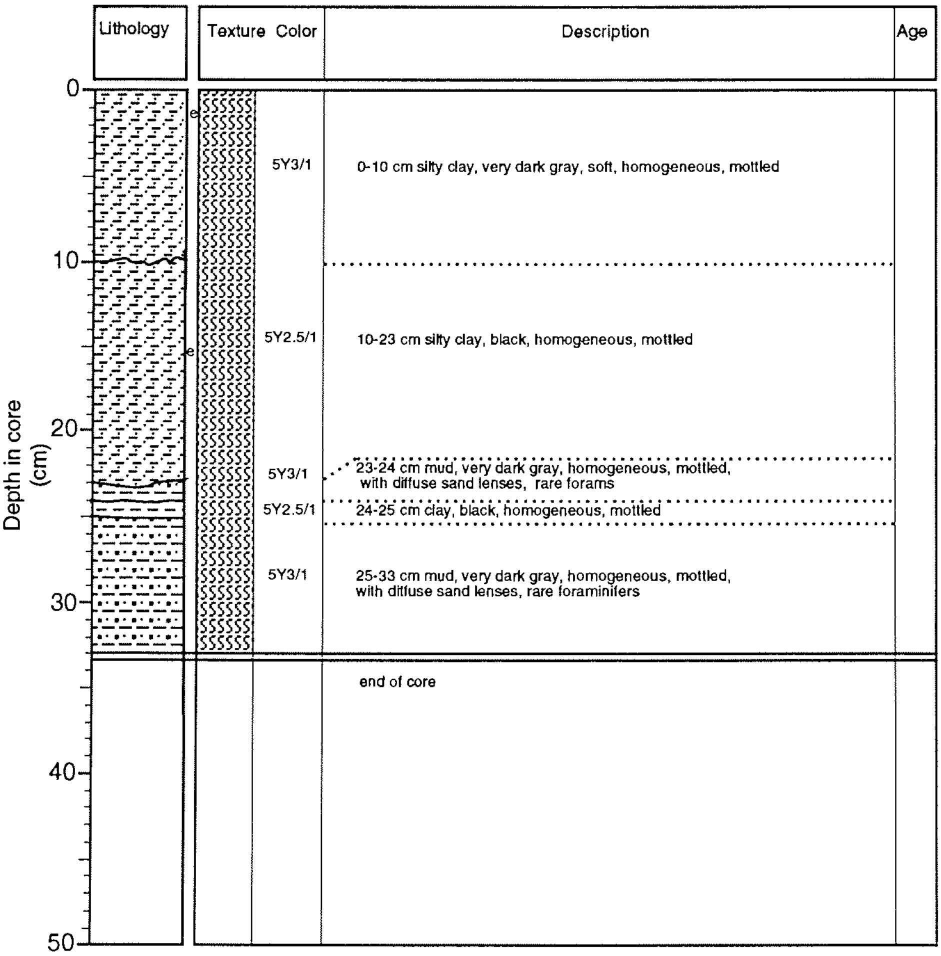


IK93Z4-3 (KG) Loc.: Lena mouth **TRANSDRIFT I**

Recovery: 0.33 m 72°01.90´ N, 130°07.55´ E Water depth: 14 m

T=+1.4°C

Surface silty clay, dark olive gray (5Y3/2), soft, common small worms, trace marks

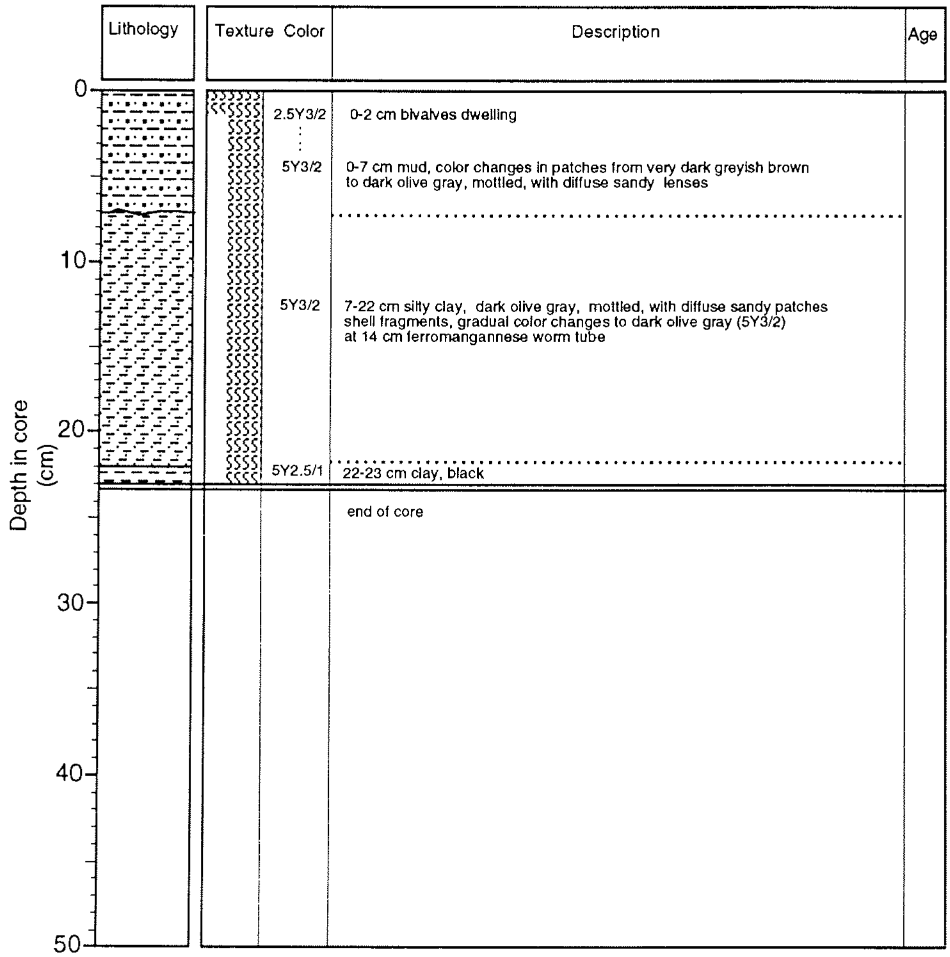


IK93Z5-4 (KG) Loc.: Yana mouth **TRANSDRIFT I**

Recovery: 0.23 m 71°41.41´ N, 137°00.40´ E Water depth: 11 m

T=+1.8°C

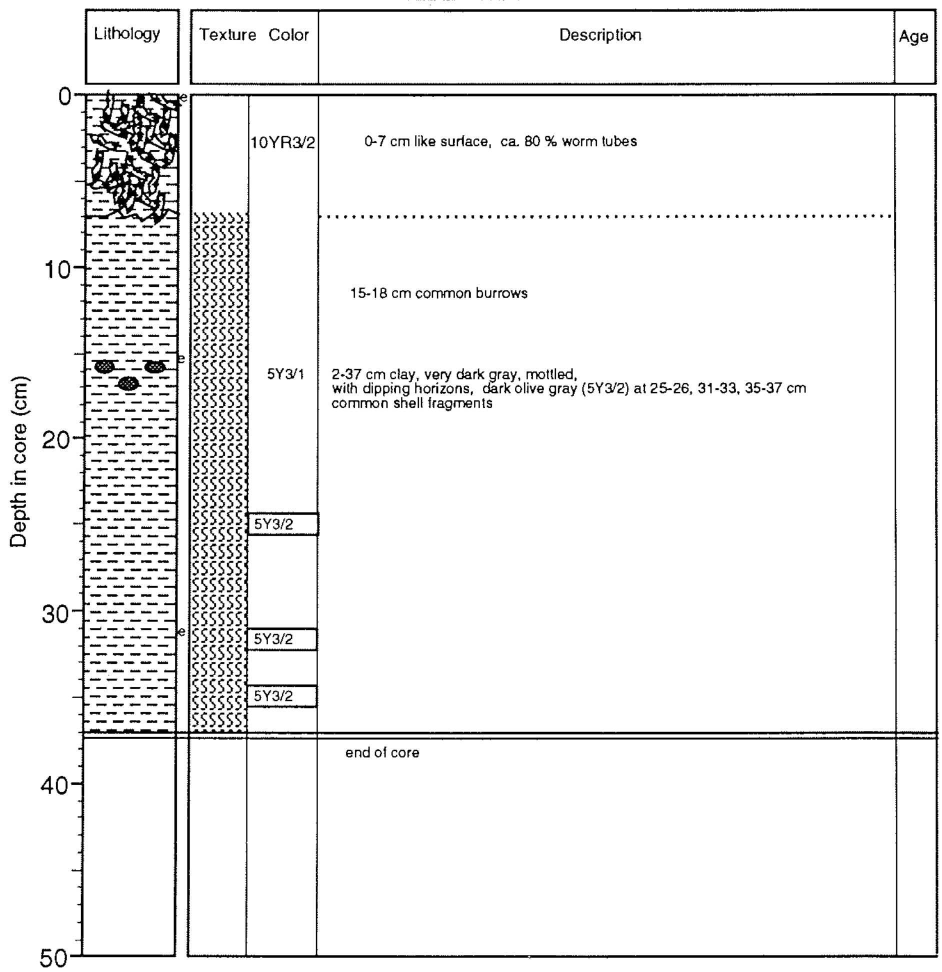
Surface mud, very dark greyish brown (2.5Y3/2), mottled, soft, patches of plant debris common bivalves producing tracemarks



IK9306-5 | Loc.: Central gulf of Buorkhoya, | **TRANSDRIFT I**
(KG) | East of Tiksi |
Recovery: 0.37 cm | 72°00.63´ N, 130°59.23´ E | Water depth: 17.5 m

T= -1.3°C

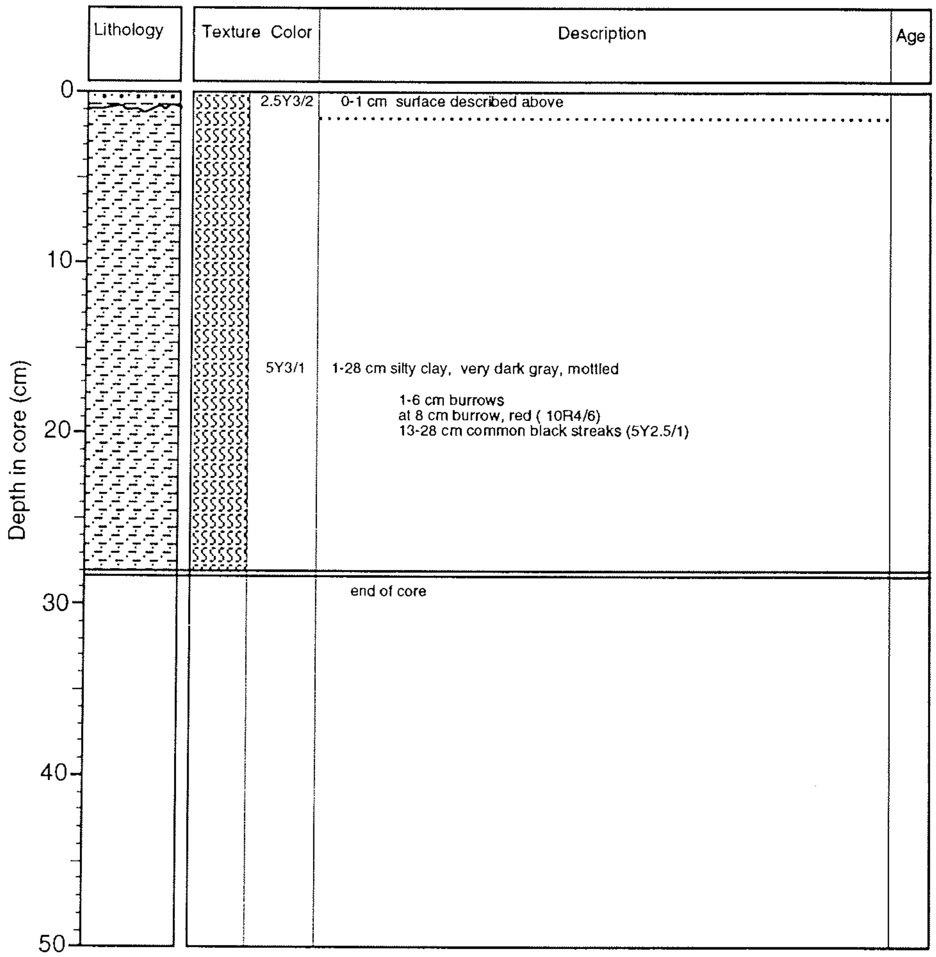
Surface: clay, very dark greyish brown (10YR3/2), soft
abundant worm tubes, mainly ferromanganese crusted, horizontal and vertical position,
common bryozoa, horizontal position, grounded 1-2 cm deep



IK9307-3 (KG) Loc.: Northwest of Kotelnyy **TRANSDRIFT I**

Recovery: 0.28 m 72°32.97´ N 131°17.80´ E Water depth: 20.7 m

Surface mud, very dark greyish brown (2.5Y3/2), soft, mottled



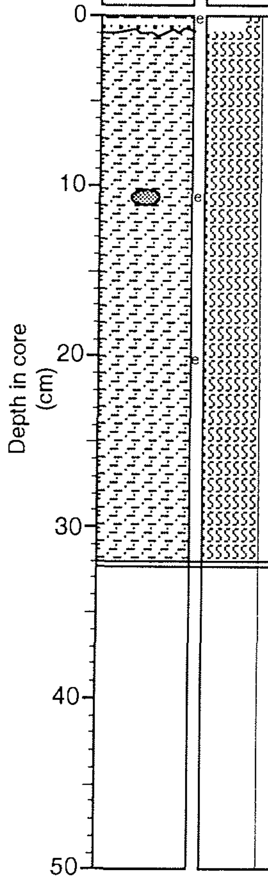
IK9309-2 (KG) Loc.: North of Yana delta **TRANSDRIFT I**

Recovery: 0.32 m 72°29.51´ N 136°35.42´ E Water depth: 24 m

T= -1.8°C

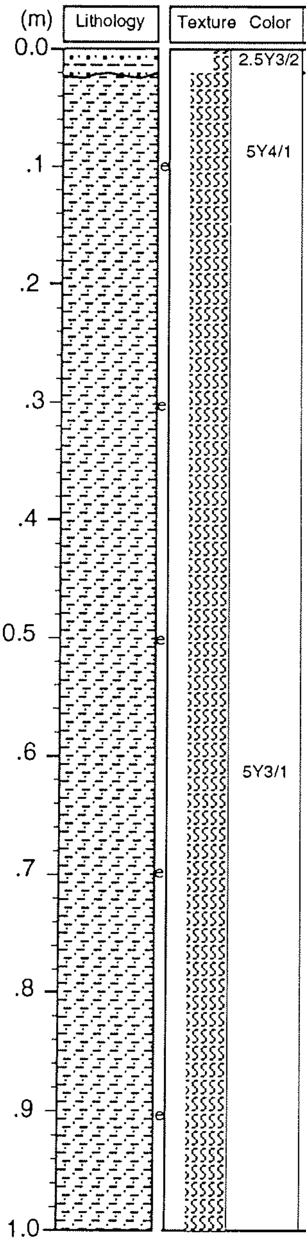
Surface mud, very dark greyish brown (2.5Y3/2), soft, mottled
rare bivalves, rare plant debris

Lithology	Texture	Color	Description	Age
		2.5Y3/2	0-1 cm surface described above	
		5Y3/1	1-28 cm silty clay, very dark gray, mottled 10-11 cm burrow, red (10R4/6) 20-32 cm common black streaks (5Y2.5/1)	
			end of core	



IK9309-6 (KL) LOC.: North of Yana delta **TRANSDRIFT I**

Recovery: 1.48 m +0.1m CC 72°29.07´ N, 136°34. 87´E Water depth: 23.4 m



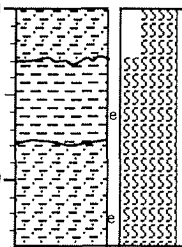
Color	Description	Age
2.5Y3/2	0-2 cm mud, very dark greyish brown, soft, mottled	
5Y4/1	2-106 cm silty clay, dark gray, mottled, with common black streaks	
5Y3/1	at 66 cm color change to very dark gray	

IK9313-7 (KG) Loc.: North of Station 12 **TRANSDRIFT I**

Recovery: 0.14 m 73°04.28´ N, 139°25.82´ E Water depth: 16.4 m

T=-1.7°C

Surface: silty clay, dark olive gray (5Y3/2), common mud clasts, rare small bivalves, agglutinated small worm tubes, bivalve shells and plant fragments



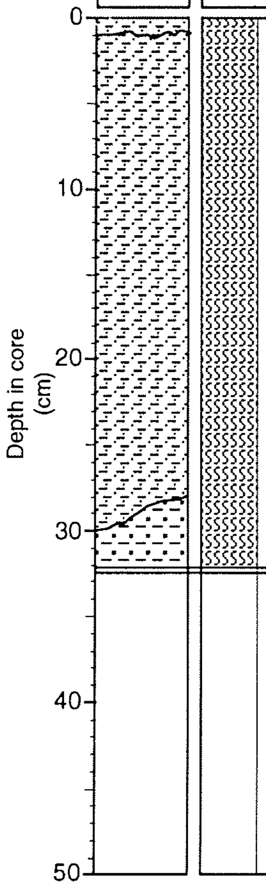
Depth in core (cm)	Color	Description	Age
0-3	5Y3/2	0-3 cm surface described above	
3-8	5Y3/1	3-8 cm clay, very dark gray, soft, homogeneous, mottled	
8-14		8-14 cm silty clay, very dark gray, soft, homogeneous, mottled	
3-14		3-14 cm gradual changes to diffuse fine sandy mud lenses	
		end of core	

IK9315-2 (KG) Loc.: Eastern Lena delta **TRANSDRIFT I**

Recovery: 0.32 m 73°00.02´ N, 133°28.28´ E Water depth: 17.9 m

T=-1.0°C

Surface silty clay, very dark greyish brown (10YR3/2), smooth, mottled, common mud clasts, very dark gray (5Y3/1), abundant worm tubes (sometimes ferromanganese crusts), bivalves



Lithology	Texture	Color	Description	Age
		10YR3/2	0-1 cm surface described above	
			1-11 cm common burrows, dark red (2.5YR3/6), also at 21 cm	
		5Y3/1	1-28 cm silty clay, very dark gray, mottled, with gradual color changes to black (5Y2.5/1)	
		5Y4/2	28-32 cm sandy clay, olive gray	
			end of core	

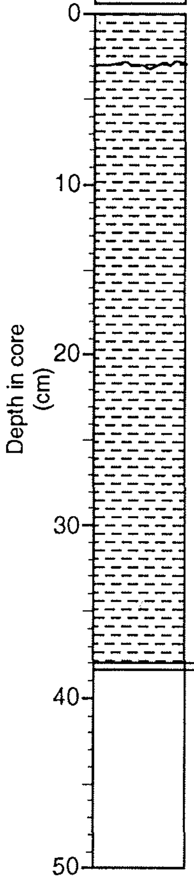
IK9316-8 (KG) Loc.: East of Girgorij **TRANSDRIFT I**

Recovery: 0.38 m 73°00.06´ N, 131°30.09´ E Water depth: 27.8 m

T=-1.7°C

Surface clay, dark brown (7.5YR3/2) and very dark greyish brown (2.5Y3/2), soft, inconsistant

Lithology	Texture	Color	Description	Age
		7.5Y3/2 2.5Y3/2	0-3 cm surface described above	
		5Y3/1 5Y2.5/2	3-38 cm clay, very dark gray gradual changing to black colors, homogeneous, mottled, common black streaks (5Y2.5/1), common bivalve shell fragments	
			end of core	



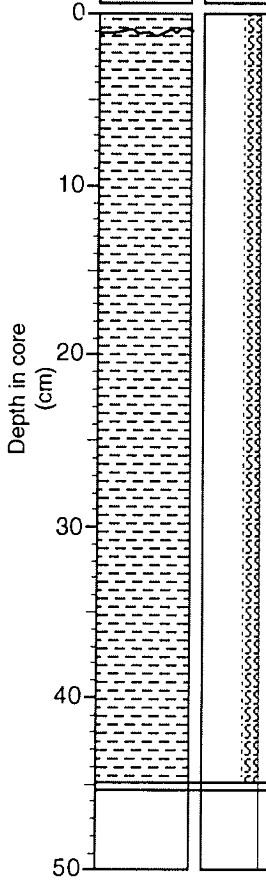
IK9318-5 (KG) Loc.: South of Stolbovoy island **TRANSDRIFT I**

Recovery: 0.42 m 73°29.84´ N, 137°33.05´ E Water depth: 24 m

T=-1.9°C

Surface clay, dark olive gray (5Y3/2), soft

Lithology	Texture	Color	Description	Age
		5Y3/2	0-1 cm surface described above	
		5Y3/1	1-45 cm clay, very dark gray, soft, homogeneous, mottled, common black streaks (5Y2.5/1), common bivalves	
			end of core	

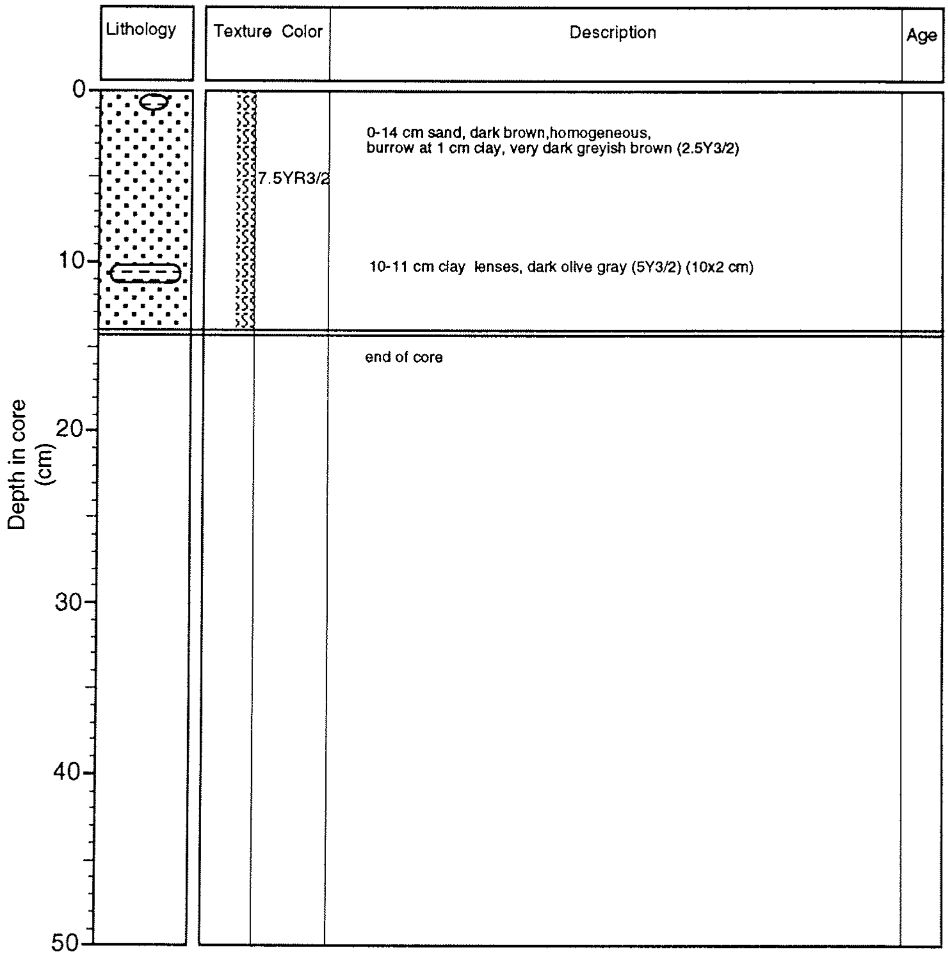


IK9320-2 (KG) Loc.: Outer Buorkhaya Gulf **TRANSDRIFT I**

Recovery: 0.14 m 73°29.70´ N, 133°31.509´ E Water depth: 18 m

T=-0.3°C

Surface sand, dark brown (7.5YR3/2),with clay patches, dark olive gray (5Y3/2) common bivalves, rare worm tubes

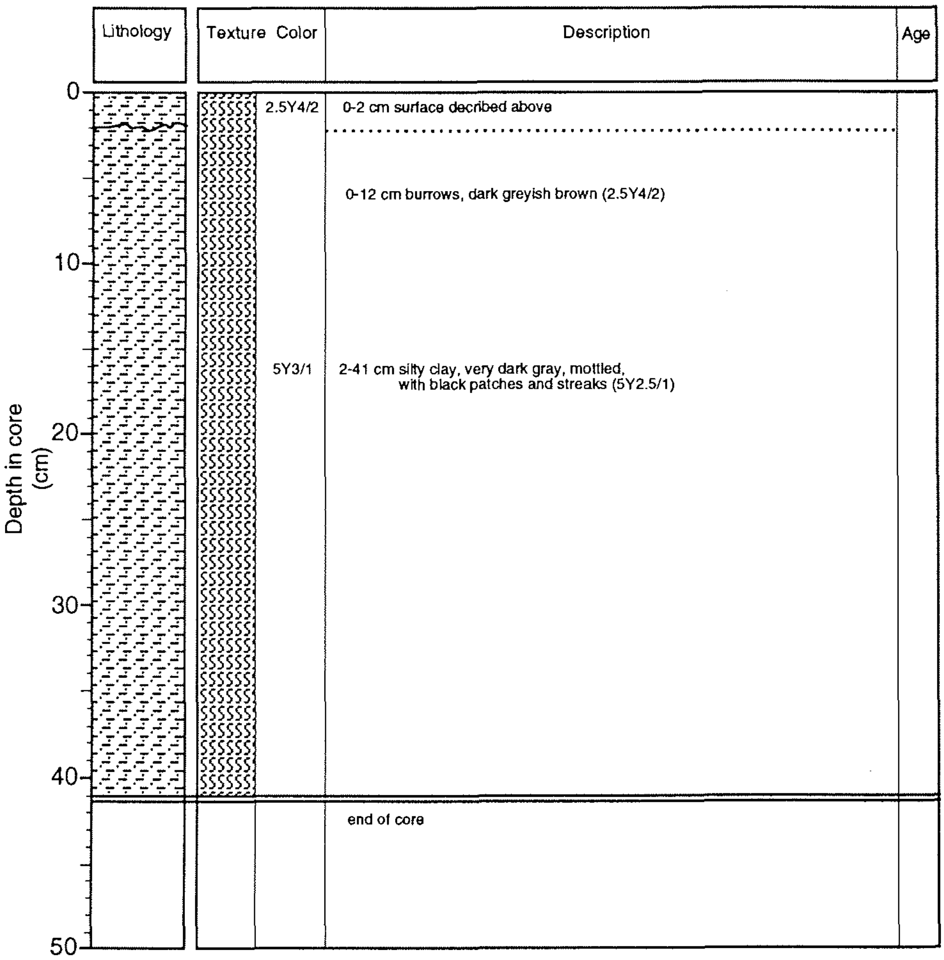


IK9321-4 (KG) Loc.: Eastern Lena delta **TRANSDRIFT I**

Recovery: 0.41m 73°28.94´ N, 131°39.04´ E Water depth: 24.6 m

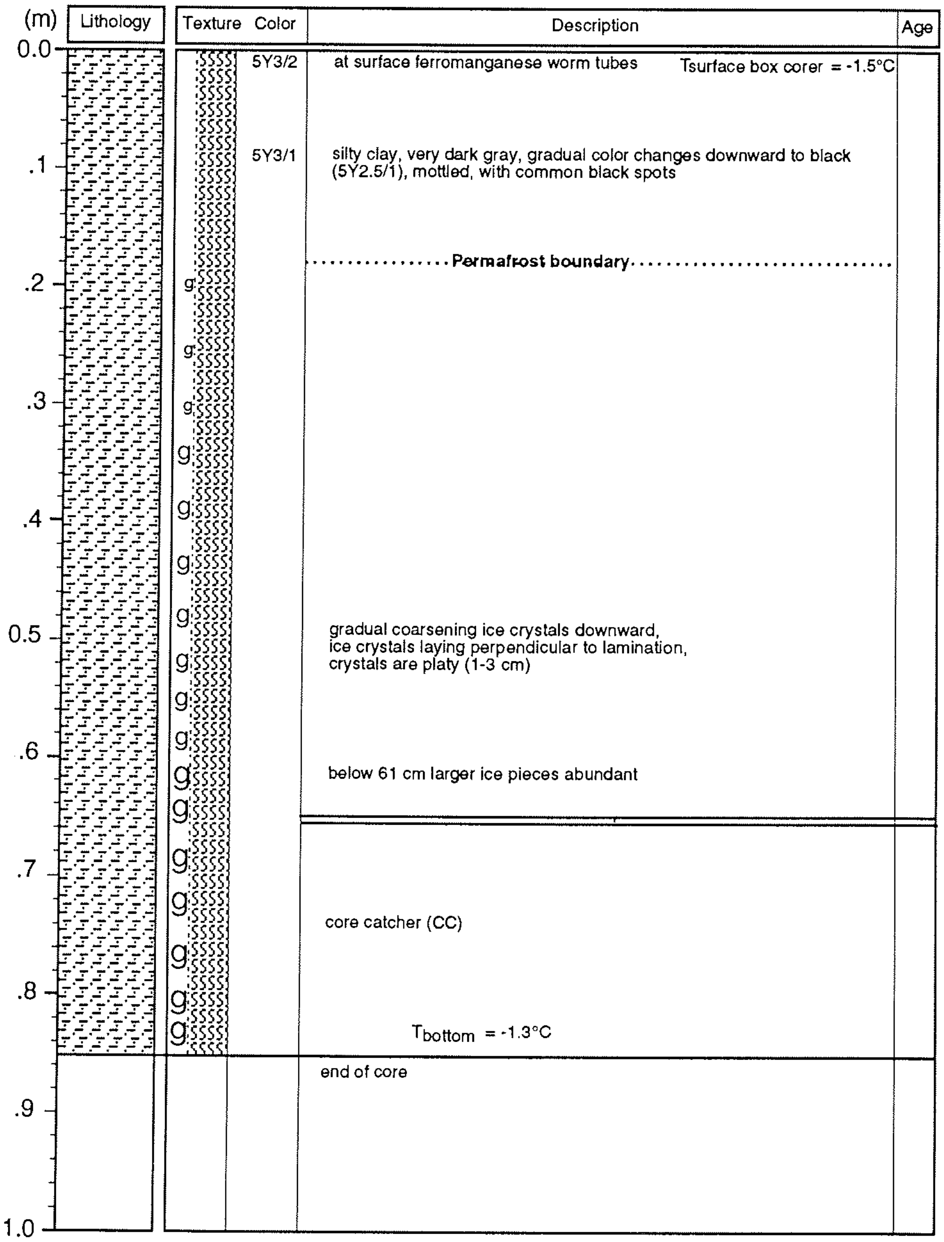
T=-1.5°C

Surface silty clay, dark greyish brown (2.5Y4/2), soft, smooth, mottled



IK9321-8 (KL) LOC.: Eastern Lena delta **TRANSDRIFT I**

Recovery: 0.65 m +0.2 m CC 73°27.98′ N, 131°38. 59′E Water depth: 24 m



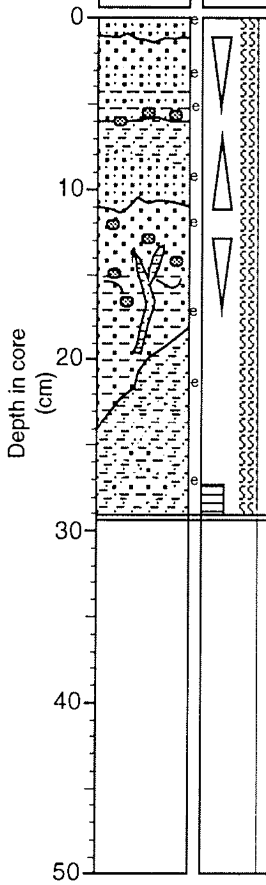
IK9323-5 (KG) | Loc.: North of Lena delta | **TRANSDRIFT I**

Recovery: 0.29 m | 73°37.81´ N, 129°39.19´ E | Water depth: 17 m

T=-1.0°C

Surface — sand, dark olive gray (5Y3/2), coarse sand lenses abundant Pogonophora, rare bivalves, rare worm tubes

Lithology	Texture	Color	Description	Age
		5Y3/2	0-1 cm surface described above	
		5Y3/2	1-6 cm mud, dark olive gray, grading upward into coarse sand, upper boundary bioturbated, common burrows at 6 cm, dark brown (7.5YR3/4)	
		5Y2.5/1 5Y3/1	6-11 cm sandy silt, very dark gray, fining upward into clayey, sandy silt, black wavy, unregular boundary (ca. 1 cm wide)	
		5Y4/2 5Y2.5/1	11- max. 24 cm clayey sand, black, grading upward into middle to coarse sand 14 cm gradual color change to olive gray 11 to 17 cm burrows filled with sandy clay (dark gray) 15-16 cm shell fragments	
		5Y3/1	max. 18- 29 cm sandy clay, very dark gray, with gradual changing sand content	
			end of core	



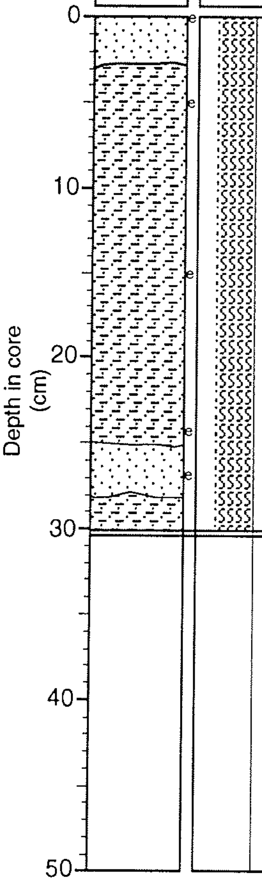
IK9324-3 (KG) Loc.: Lena western mouth **TRANSDRIFT I**

Recovery: 0.30 m 73°30.10´ N, 121°40.08´ E Water depth: 13 m

T=-1.8°C

Surface sandy silt, olive gray (5Y4/2), bioturbated
common amphipodes, bivalves, bryozoans, worm tubes, (mesodothea antomon)

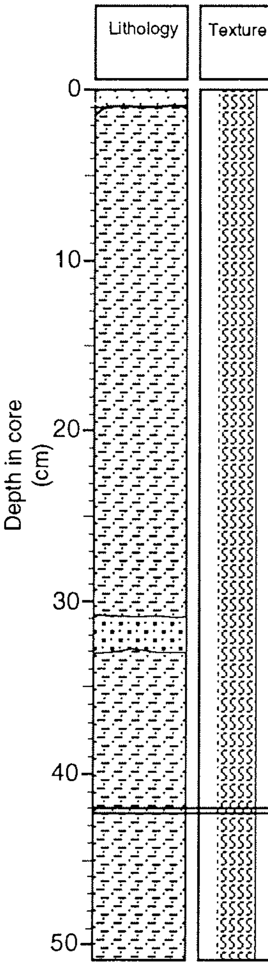
Lithology	Texture	Color	Description	Age
		5Y4/2	0-3 cm sandy silts, olive gray (5Y4/2), bioturbated	
		5Y3/1	3-30 cm silty clay, very dark grey, strongly bioturbated 3-10 cm common olive gray (5Y3/2) patches and streaks at 6 cm some dark yellowish brown (10YR4/4) spots (burrows)	
			25-28 cm fine sand layer	
			end of core	



IK9324-5 (KL) Loc.: Lena western mouth **TRANSDRIFT I**

Recovery: 0.42 m + 0.1 m CC 73°30.12´ N, 121°40.13´ E Water depth: 13 m

Surface disturbed, sandy silt, olive gray (5Y4/2), bioturbated
common amphipodes, bivalves, bryozoan, worm tubes, (mesodothea antomon)
(description from box corer IK9324-3)



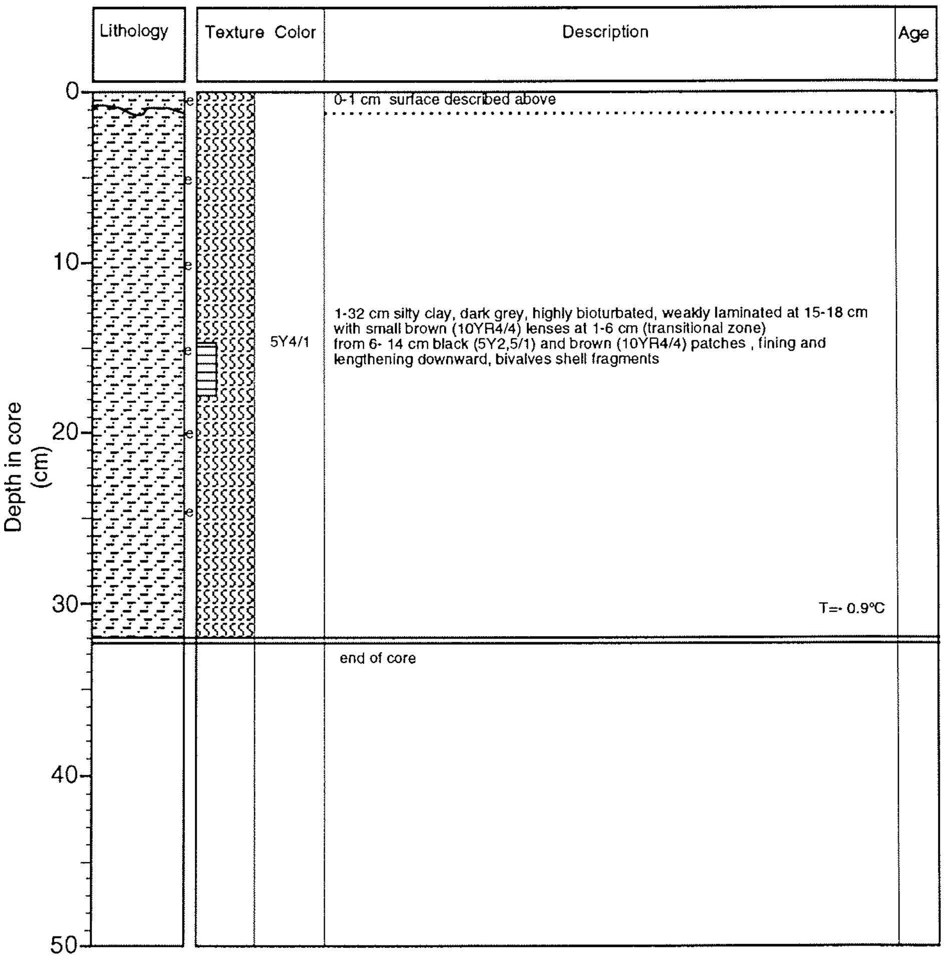
Color	Description	Age
5Y4/2	0-1 cm sandy silts, olive gray, bioturbated	
5Y3/1	1-42 cm silty clay, vary dark gray, strongly bioturbated 3-10 cm common dark olive gray (5Y3/2) patches and streaks at 6 cm some dark yellowish brown (10YR4/4) spots (burrows) 10-25 cm black vertical streaks	
5Y3/2	31-33 cm fine sand layer, lenses, dark olive gray	
	42-52 cm core catcher (CC)	
	at 52 cm end of core	

IK9327-5 (KG) Loc.: Western Laptev Sea **TRANSDRIFT I**

Recovery: 0.32 m 73°59.98´ N, 119 °51.67´ E Water depth: 30 m

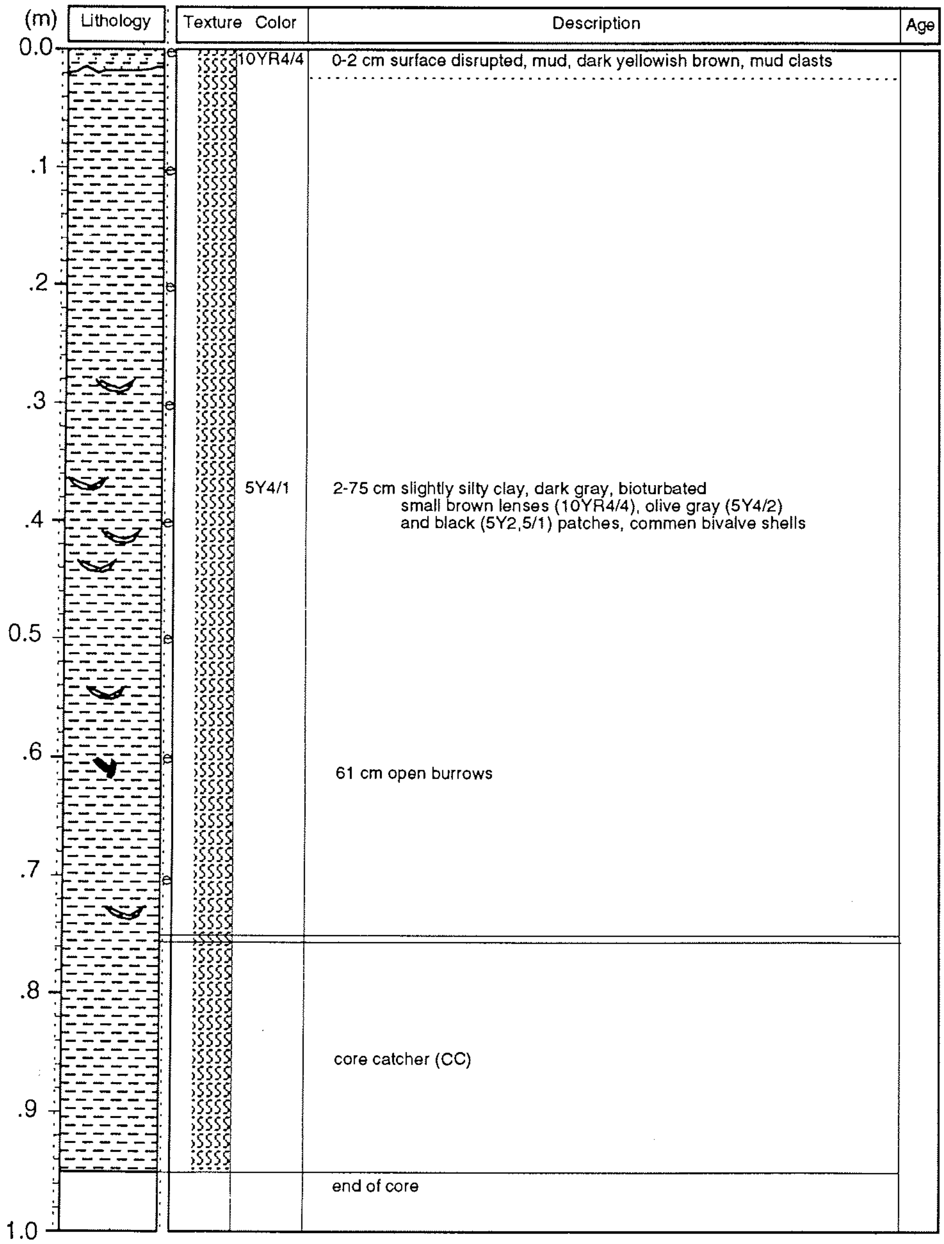
T=+0.8°C

Surface mud, dark yellowish brown (10YR4/4), mud clasts (N4 gley table), trace marks



IK9327-9 (KL) LOC.: Olenek mouth near Leikina island **TRANSDRIFT I**

Recovery: 0.75 m + 0.2 m CC 73°59.78 N, 119°51.72 ´ E Water depth: 30 m



IK9330-4 (KG) Loc.: North of Lena delta **TRANSDRIFT I**

Recovery: 0.34 m 74°00.03´ N, 127°30.25´ E Water depth: 27 m

T=-1.8°C

Surface weakly silty clay, very dark greyish brown (2.5Y3/2), soft, smooth, mottled, trace marks, common worm tubes, rare brittle stars

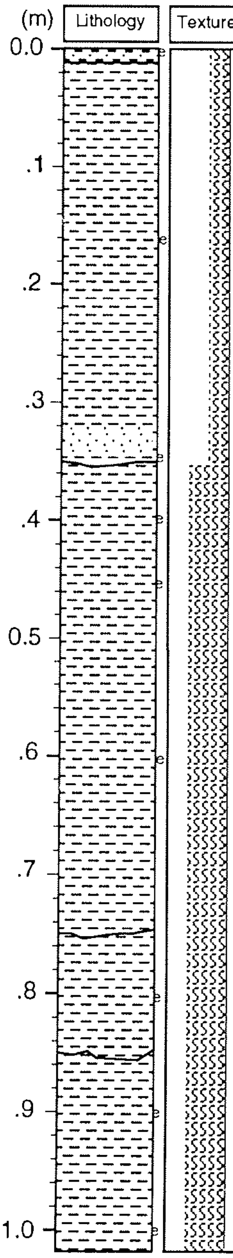
Lithology	Texture	Color	Description	Age
		2.5Y3/2	0-2 cm surface described above	
		5Y3/2	2-34 cm weakly silty clay, dark olive gray, mottled horizontal black streaks and patches, abundant shell fragments	
			at 32-33 cm burrow	
			end of core	
			notes: IK9330-5 $T_{surface}$= -1.7°C	

Depth in core (cm)

0 10 20 30 40 50

IK9334-10 (KL) LOC.: Stolbovoy island **TRANSDRIFT I**

Recovery: 1.02 m +0.2 m CC 73°59.89´ N, 137°39.87´ E Water depth: 22 m



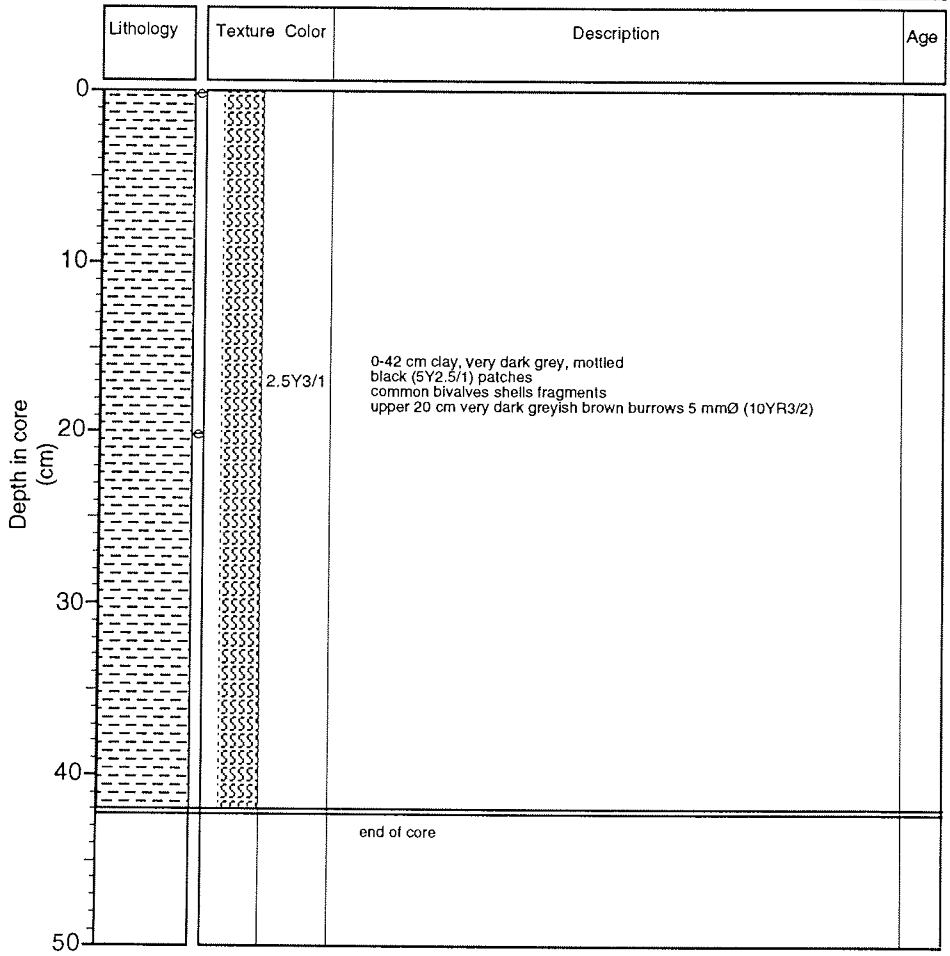
Texture Color	Description	Age
2.5Y3/2	0-1 cm surface: see description of box corer IK9334-6	
5Y3/1	1-35 cm clay, dark gray, poorly mottled, in upper 20 cm rare burrows (10YR3/2) 32-35 cm diffuse silty layer	
5Y3/1	35-75 cm clay, dark gray with darker layer (5Y2.5/1 black) at 37-38, 43-45 and 69-70 cm	
5Y3/1	75-85 cm clay, very dark gray, rare dark patches	
5Y3/1	85-102 cm clay, very dark gray, common dark patches + 20 cm CC (end of core at 1.22m)	

IK9334-6 (KG) Loc.: Stolbovoy island **TRANSDRIFT I**

Recovery: 0.42 m 74°00.39´ N, 137°39.85´ E Water depth: 22 m

T=-1.7°C

Surface weakly silty clay, very dark greyish brown (2.5Y3/2), soft, mottled



IK9336-3 (KG) Loc.: Anabar - Khatanga region **TRANSDRIFT I**

Recovery: 0.10 m 74°29.55´ N, 115 °59.02´ E Water depth: 15.5 m

Surface sand, dark yellowish brown (10 YR4/4), bioturbated, abundant clay clasts, clay lenses (7-8 cm Ø x 1 cm), dark olive gray (5Y3/2), common worm tubes

Depth in core (cm)	Lithology	Texture	Color	Description	Age
0			10YR4/4	upper 1 cm surface described above	
			2,5Y5/2	1-10 cm sand, dark greyish brown, mottled	
				beneath 5 cm black (2,5Y2/0) clay lenses surrounded by muddy sand	
10				end of core	
20					
30					
40					
50					

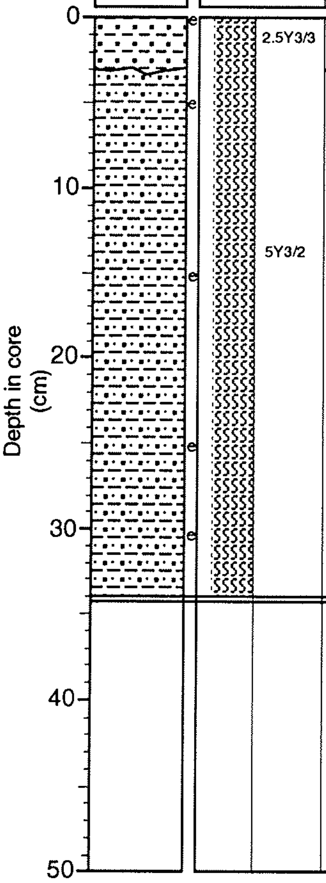
IK9338-4 (KG) Loc.: Olenek valley **TRANSDRIFT I**

Recovery: 0.34 m 74°29.63´ N, 119°57.38´ E Water depth: 34.15 m

T=-2.2°C

Surface sandy mud, dark greyish brown (2.5Y3/3), sand lenses (e), mud clasts (e)
abundant brittle stars, bivalves, worm tubes, bryozoa, hydrozoa, porifera

Lithology	Texture	Color	Description	Age
		2.5Y3/3	0-3 cm surface described above	
		5Y3/2	3-33 cm sandy clay, dark olive gray, bioturbated 3-10 cm dark yellowish brown (10YR4/4) oxidized patches (burrows) 8 and 14 cm common worms lower part abundant dark gray (5Y3/1) and black (5Y2.5/1) patches and streaks open burrows at 20 and 28 cm	
			end of core	



IK9340-5 (KG) Loc.: Glubin high **TRANSDRIFT I**

Recovery: 0.13 m 74°30.01´ N, 122°59.64´ E Water depth: 13 m

bottom water T=+1.9°C
surface sediment T=+1.2°C

Surface silty sand, dark brown (7.5YR3/2), abundant brittle stars, bivalves, gastropods, holothurians, brachiopods

Lithology	Texture	Color	Description	Age
		7.5YR3/2	0-5 cm silty sand, dark brown, bioturbated, shell fragments	
		5Y3/1	5-11 cm silty sand, very dark gray, bioturbated, abundant worms, shell fragments	
		5Y2.5/1	11-13 cm clayey sand, black, bioturbated	
			end of core	

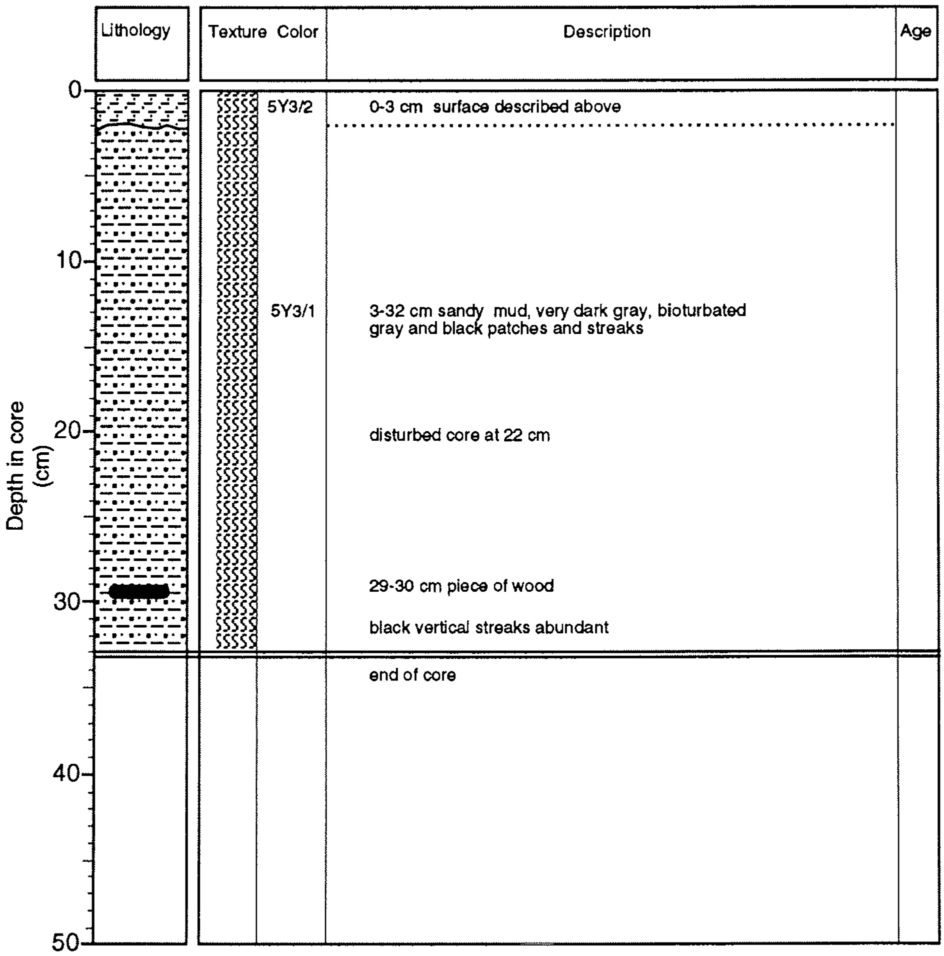
Depth in core (cm): 0, 10, 20, 30, 40, 50

IK9342-5 (KG) Loc.: north of Lena delta **TRANSDRIFT I**

Recovery: 0.32 m 74°30.50´ N, 127°20.65´ E Water depth: 34 m

T=-1.8°C

Surface silty clay, dark olive gray (5Y3/2), soft, smooth, mottled, common brittle star

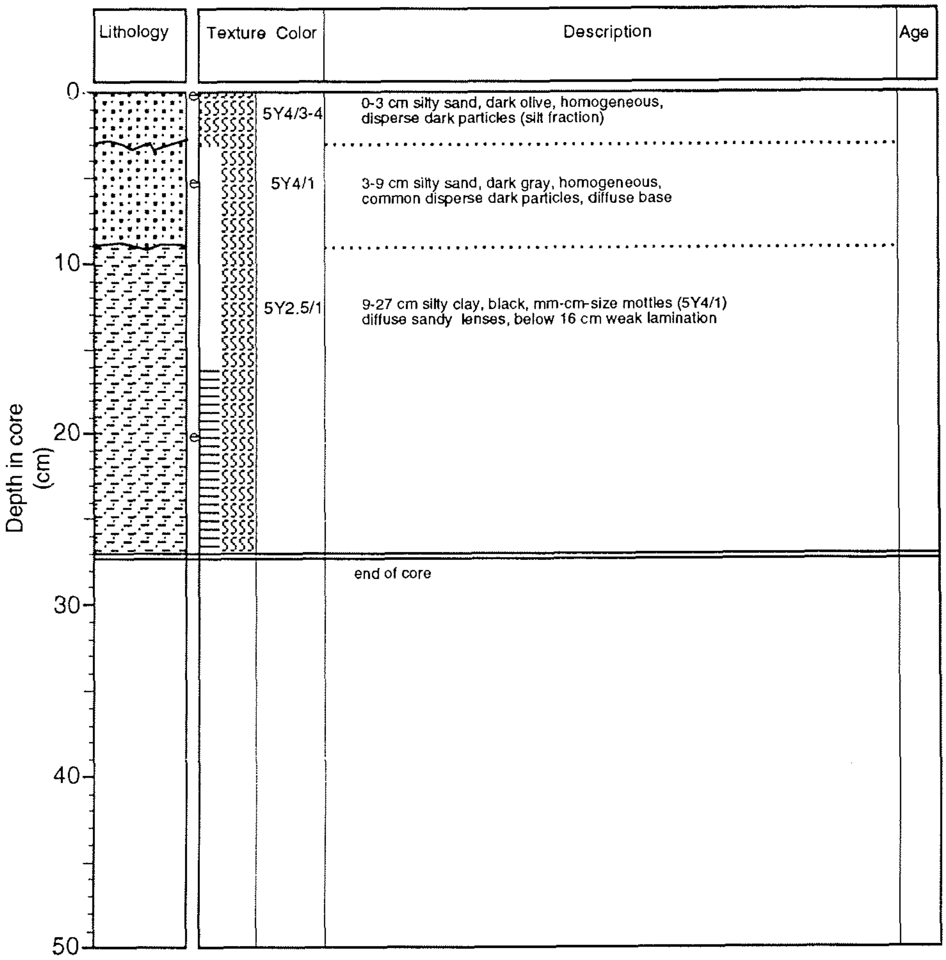


IK9344-10 (KG) Loc.: North of Lena delta **TRANSDRIFT I**

Recovery: 0.27 m 74°24.12´ N, 131°00.37´ E Water depth: 30 m

T=-1.8°C

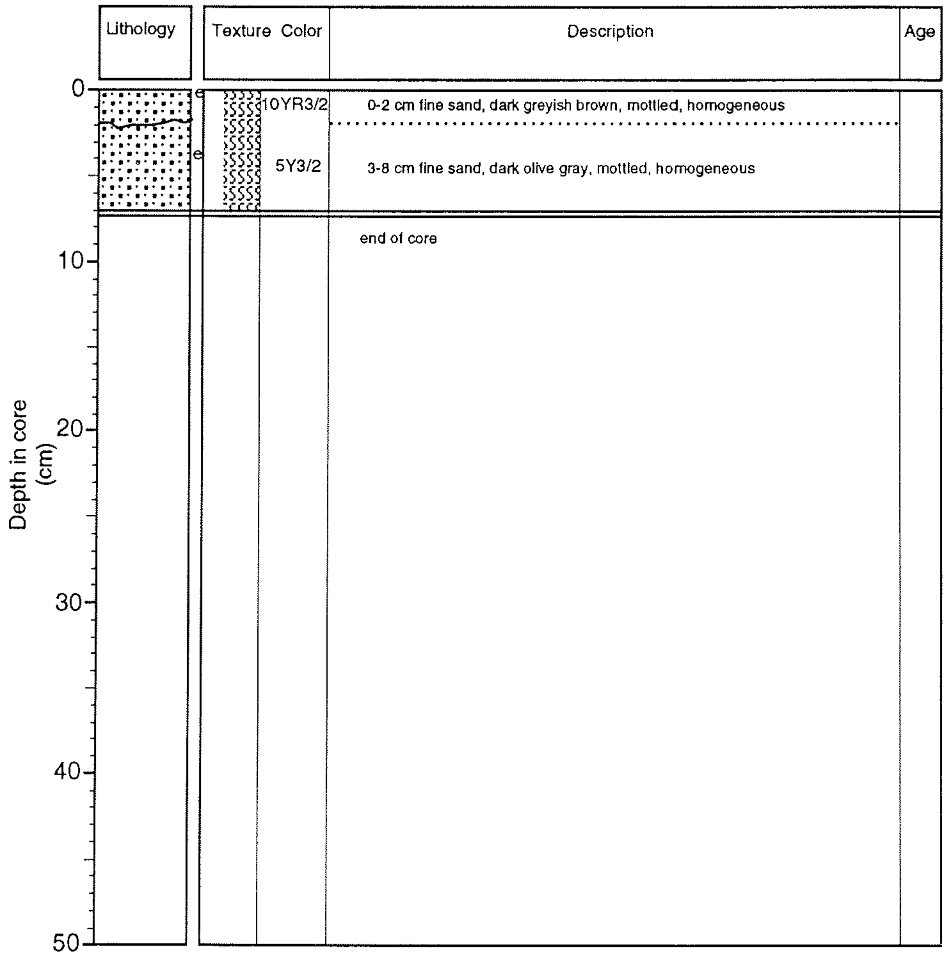
Surface silty sand, dark olive (5Y4/3-4),homogeneous
abundant bivalves, common worm tubes, amphipods



IK9346-5 (KG) Loc.: NW Stolbovoy island **TRANSDRIFT I**

Recovery: 0.08 m 74°29.68´ N, 134°02.32´ E Water depth: 14 m

Surface fine sand, very dark greyish brown (10YR3/2), mottled
commen amphipods

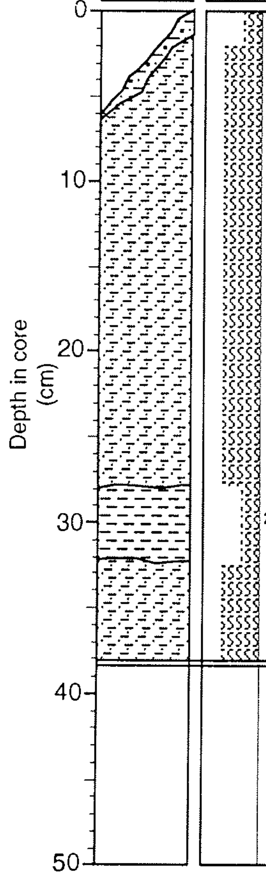


IK9348-5 (KG) | Loc.: Yana valley | **TRANSDRIFT I**

Recovery: 0.38 m | 74°28.96´ N, 137°02.53´ E | Water depth: 21.5 m

T=-1.9°C

Surface — mud, dark olive gray (5Y3/2), erosive surface
common sponges, worm tubes, rare foraminifers



Lithology	Texture	Color	Description	Age
		5Y3/2	0-2 cm erosive surface covered by 1-2 cm mud, dark olive gray	
		5Y3/1	2-22 cm silty clay, very dark gray , mottled upper 5 cm abundant sandy burrows, dark greyish brown (2.5Y3/2) with red center (2.5YR4/8) 12-17 cm mottled with dark olive gray (5Y3/2) patches and streaks	
		2.5Y2/0	28-32 cm clay , black with black spots	
		5Y3/1	32-38 cm silty clay, very dark gray, mottled	
			end of core	

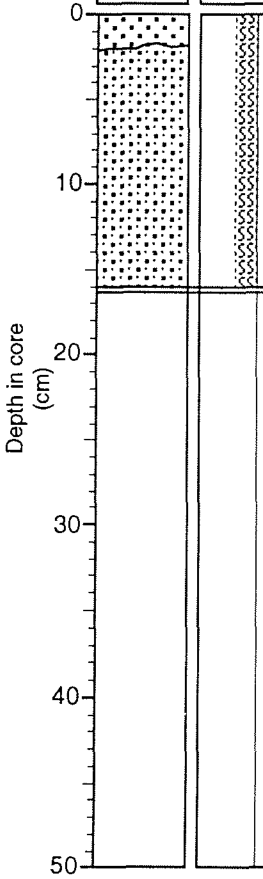
IK9349-7 (KG) Loc.: western sea passage, Samurkoba-Nori **TRANSDRIFT I**

Recovery: 0.16 m 74°30.03´ N, 139°40.18´ E Water depth: 24.5 m

T=-1.3°C

Surface medium coarse sand, very dark greyish brown (2.5Y3/2), smooth, homogeneous, vertical manganese nodules common worm tubes

Lithology	Texture	Color	Description	Age
		2.5Y3/2	0-2 cm surface described above	
		5Y3/2	2-15 cm sand, dark olive gray, with silty lenses with black (5Y2.5/1) and very dark greyish brown (2.5Y3/2) streaks common worms at 4 cm	
			end of core	

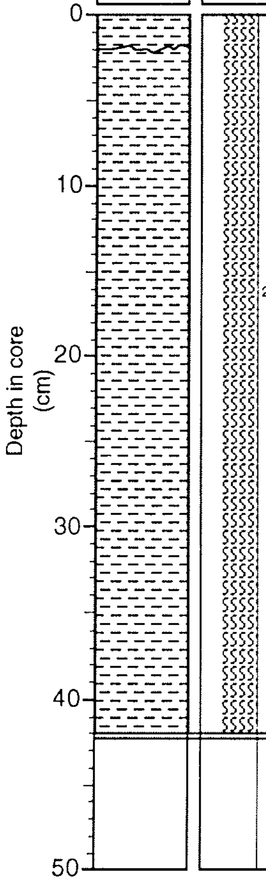


IK9350-7 (KG) — Loc.: Southwest of Kotelnyy, Southeast of Belkovskij — **TRANSDRIFT I**

Recovery: 0.42 m — 75°00.83´ N, 136°01.66´ E — Water depth:30 m

T=-1.3°C

Surface — clay, very dark greyish brown (2.5Y3/2), mottled, soft, rare bivalves



Lithology	Texture	Color	Description	Age
		2.5Y3/2	0-2 cm surface described above	
		2.5YN3/0	2-42 cm clay, very dark gray, mottled, common black streaks and patches	
			end of core	

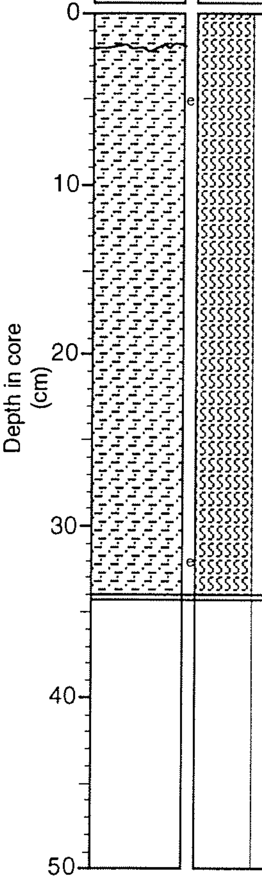
IK9353-8 (KG) Loc.: Eastern Lena valley **TRANSDRIFT I**

Recovery: 0.34 m 74°57.68´ N, 129°46.02´ E Water depth:40 m

T=-1.7°C

Surface silty clay, very dark greyish brown (2.5Y3/2), soft, mottled, common brittle stars, rare bivalves

Lithology	Texture	Color	Description	Age
		2.5Y3/2	0-2 cm surface described above	
		5Y2.5/2	2-34 cm silty clay, black, mottled, with very dark gray (5Y3/1) patches (upper 10 cm Ø=2-3 cm, 10-34 cm smaller than 1 cm) and small black (5Y2.5/1) patches rare bivalve shell fragments	
			30-34 cm slightly compacted (lenghthening of bioturbation)	
			end of core	

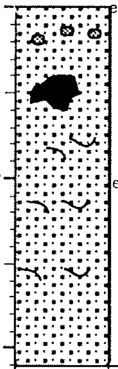


IK9356-1 (KG) Loc.: Western Lena valley **TRANSDRIFT I**

Recovery: 0.21 m 74°59.83´ N, 123°00.57´ E Water depth: 32.4 m

T=-1.6°C

Surface silty sand, vary dark greyish brown (2.5Y3/2), patchy surface
common worm tubes, rare bivalves(2 cm Ø)

Lithology	Texture	Color	Description	Age
		2.5Y3/2		
		5Y3/2	5 cm dropstone (5x2 cm), rounded, dark green sediment, quarzitic sandstone	
		5Y2.5/1	0-21 cm silty sand, very dark greyish brown, gradual color changes to very dark gray and black, bioturbated common bivalve shell fragments	
			end of core	

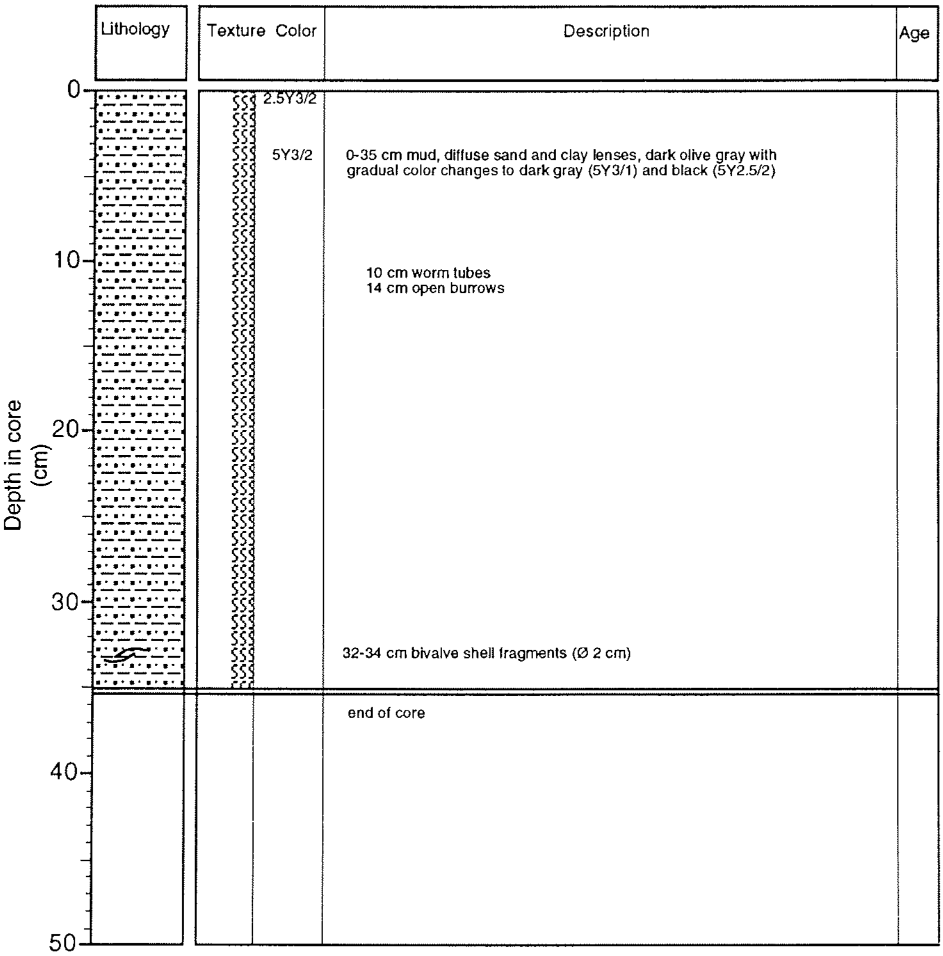
Depth in core (cm): 0, 10, 20, 30, 40, 50

IK9358-5 (KG) Loc.: Northwest of Lena delta **TRANSDRIFT I**

Recovery: 0.35 m 75°00.95´ N, 119°53.28´ E Water depth:34 m

T=-1.8°C

Surface: silty sand, very dark greyish brown (2.5Y3/2), bioturbated, dropstone (dark green sandstone1x3 cm) with manganese crust, abundant worm tubes, weak ferromanganese content, common brittle stars, common bivalves and shell fragments, rare holothurians

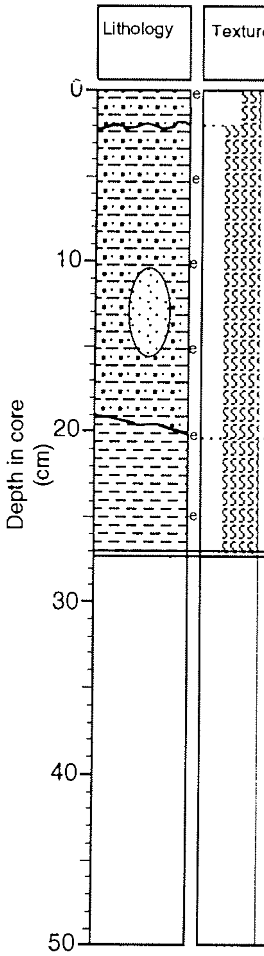


IK9361-9 (KG) Loc.: Khatanga region **TRANSDRIFT I**

Recovery: 0.27 m 74°59.62´ N, 114 °32.94´ E Water depth: 45 m

T= -0.3° C

Surface sandy mud, olive brown (2.5Y4/4), manganese nodules (6 cm Ø), bioturbated
brittle stars, bivalves (2 cm Ø), worms, amphipods
black dropstone



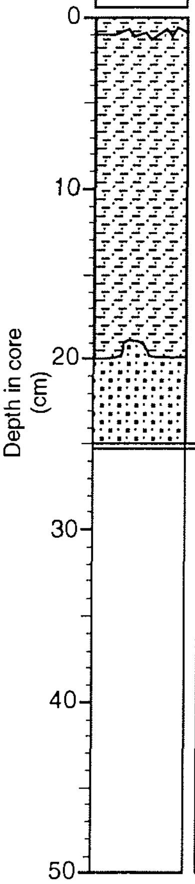
Color	Description	Age
2.5Y4/4	0-2 cm sandy mud, olive brown, homogeneous, weakly bioturbated	
5Y4/1	2-19 cm mud, dark grey, with slight brown mottles and black (2,5Y2/0) streaks beneath 10 cm, sand lense (8 cm Ø), brown beneath 10 cm	
2,5Y2/0	19-27 cm clay, black, slight gray mottles, bioturbated	
	end of core	

IK9365-8 (KG) Loc.: Western Laptev Sea Olenek valley **TRANSDRIFT I**

Recovery: 0.26 m 75°27.94′ N, 119°58.04′ E Water depth:43 m

T=-2.2°C

Surface mud, very dark greyish brown (2.5Y3/2), soft, mottled
common bivalves, common brittle stars, common worm tubes, rare hydrozoans, rare copepods, bryozoans on bivalve shell



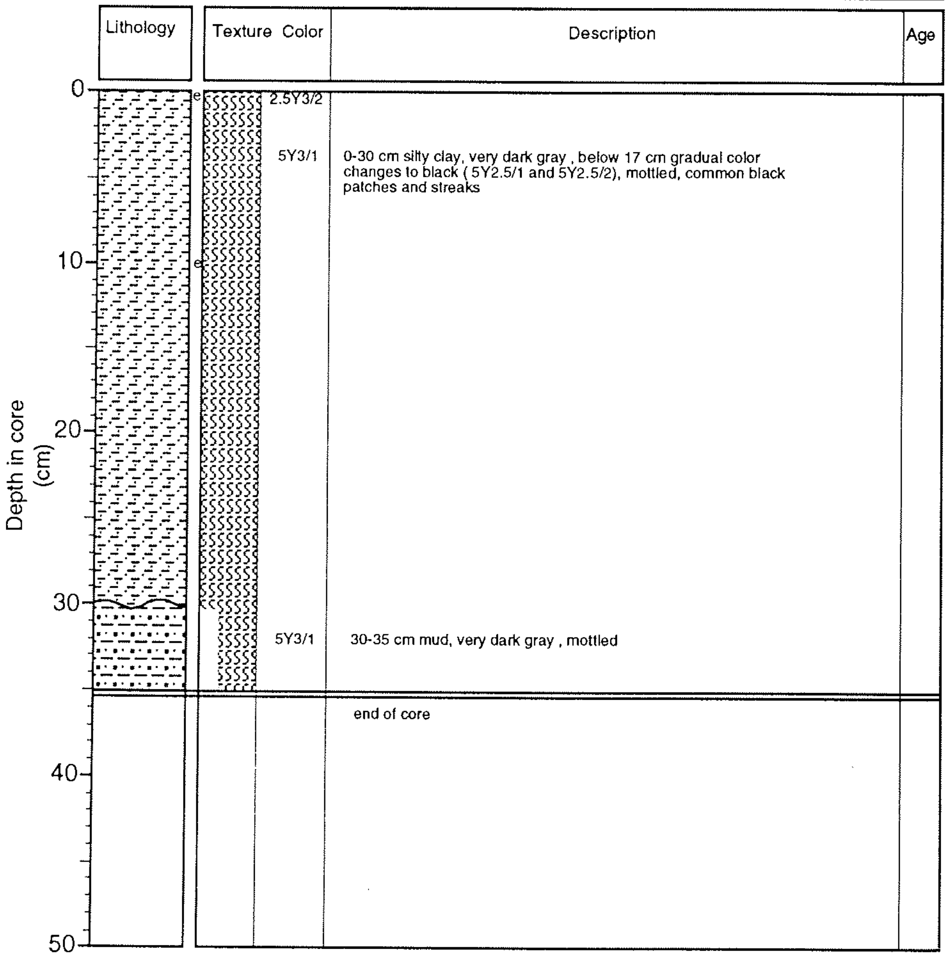
Texture	Color	Description	Age
	2.5Y3/2	0-1 cm surface described above	
		5 cm worms	
	5Y3/1	1-20 cm mud, very dark gray, mottled, gradual color changes to black (5Y2.5/1 and 5Y2.5/2), diffuse sand and clay lenses	
	5Y3/1	20-26 cm silty sand, very dark gray, "diapiric structure"	
		end of core	

IK9367-1 (KG) Loc.: Central Laptev sea **TRANSDRIFT I**

Recovery: 0.35 m 75°28.92´ N, 123°50.52´ E Water depth:44 m

T=-1.6°C

Surface silty clay, very dark greyish brown (2.5Y3/2),
common bivalves, common brittle stars, common worm tubes, partly ferromanganesed



0-30 cm silty clay, very dark gray , below 17 cm gradual color changes to black (5Y2.5/1 and 5Y2.5/2), mottled, common black patches and streaks

30-35 cm mud, very dark gray , mottled

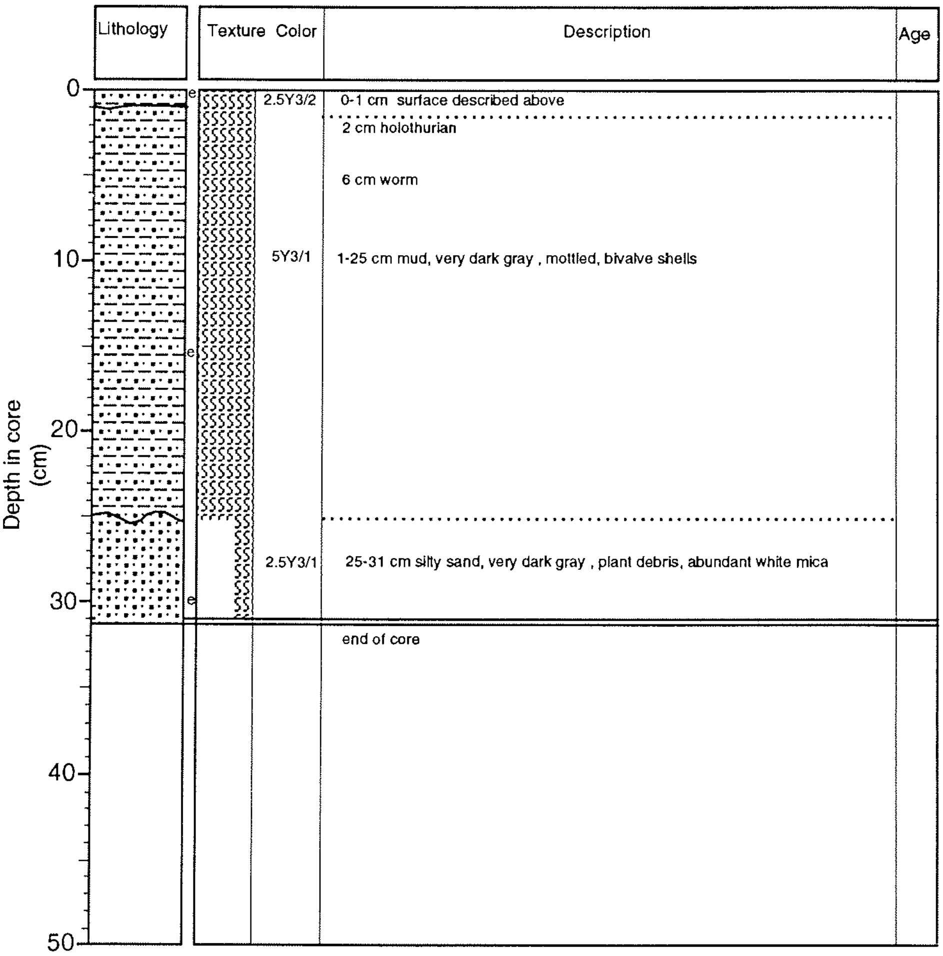
end of core

IK9368-8 (KG) Loc.: Central Laptev sea **TRANSDRIFT I**

Recovery: 0.31 m 75°25.49´ N, 125°49.84´ E Water depth: 41 m

T=-1.9°C

Surface mud, very dark greyish brown (2.5Y3/2), soft, mottled, rare bivalves, rare worm tubes, rare holothurians



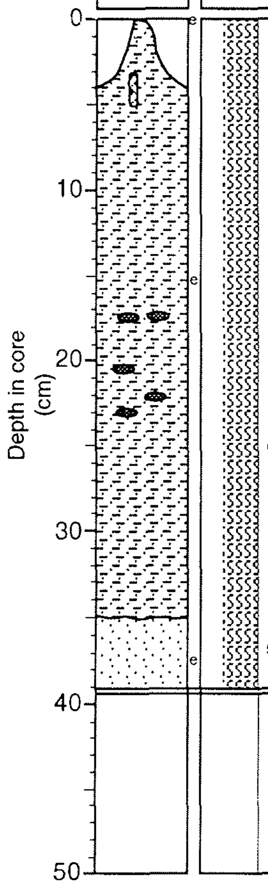
IK9370-6 (KG) | Loc.: Eastern Lena valley | **TRANSDRIFT I**

Recovery: 0.39 m | 75°17.02´ N, 129°28.55´ E | Water depth:44 m

T=-2.1°C

Surface silty clay, very dark greyish brown (2.5Y3/2) with patchy very dark gray, irregular surface, soft, mottled, rare worm tubes, rare bivalve

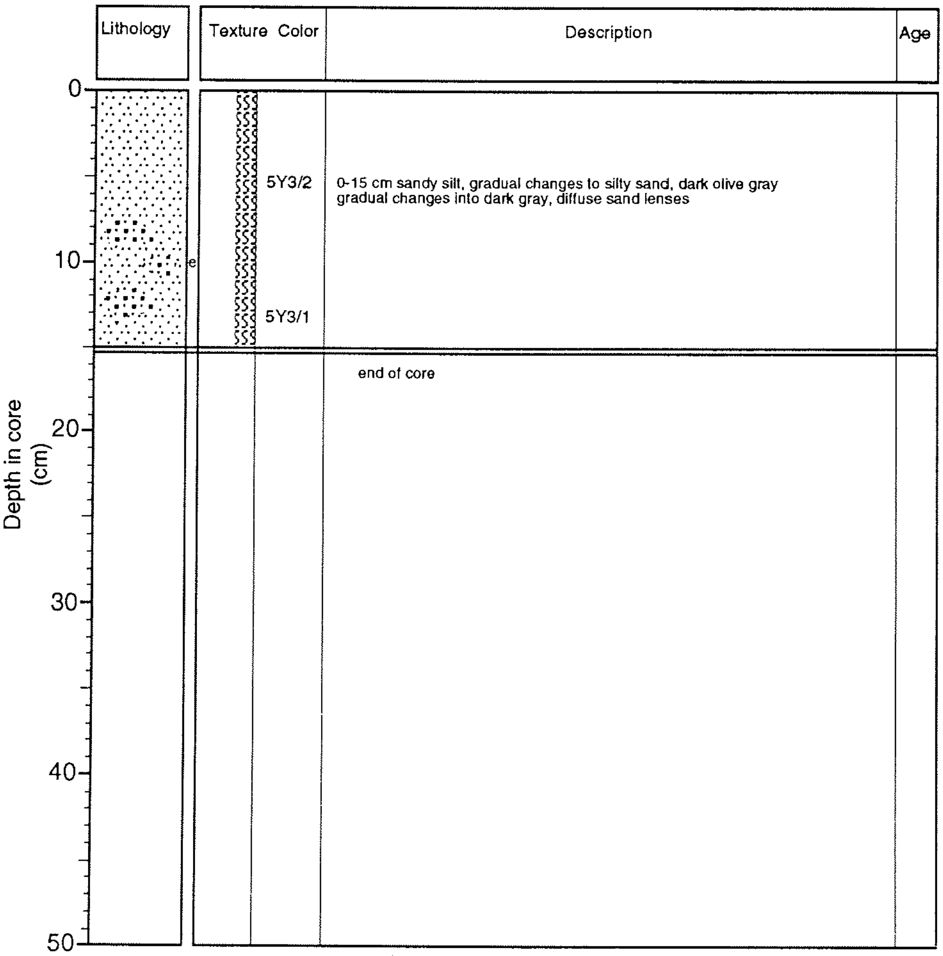
Lithology	Texture	Color	Description	Age
			5 cm worm tube	
		5Y3/2	0-35 cm silty clay, dark olive gray, mottled, gradual changes to very dark gray and black (5Y2.5/1 and 5Y2.5/2) subsequently	
		5Y3/1		
			17-18 cm burrows with sandy filling	
			20-25 cm burrows with sandy filling	
		5Y2.5/2		
		5Y2.5/1		
		5Y2.5/2	35-39 cm sandy silt, black, mottled, gradual changes to very dark gray and dark olive gray	
			end of core	



IK9371-3 (KG) Loc.: North of Vasilevsky shoal **TRANSDRIFT I**

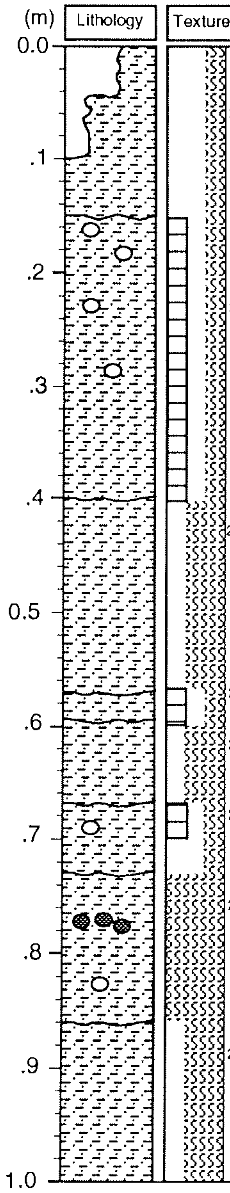
Recovery: 0.15 m 75°22.99′ N, 131°47.88′ E Water depth: 19.6 m

Surface	sandy silt, dark olive gray (5Y3/2), regular surface with few sandy patches rare bivalve shells

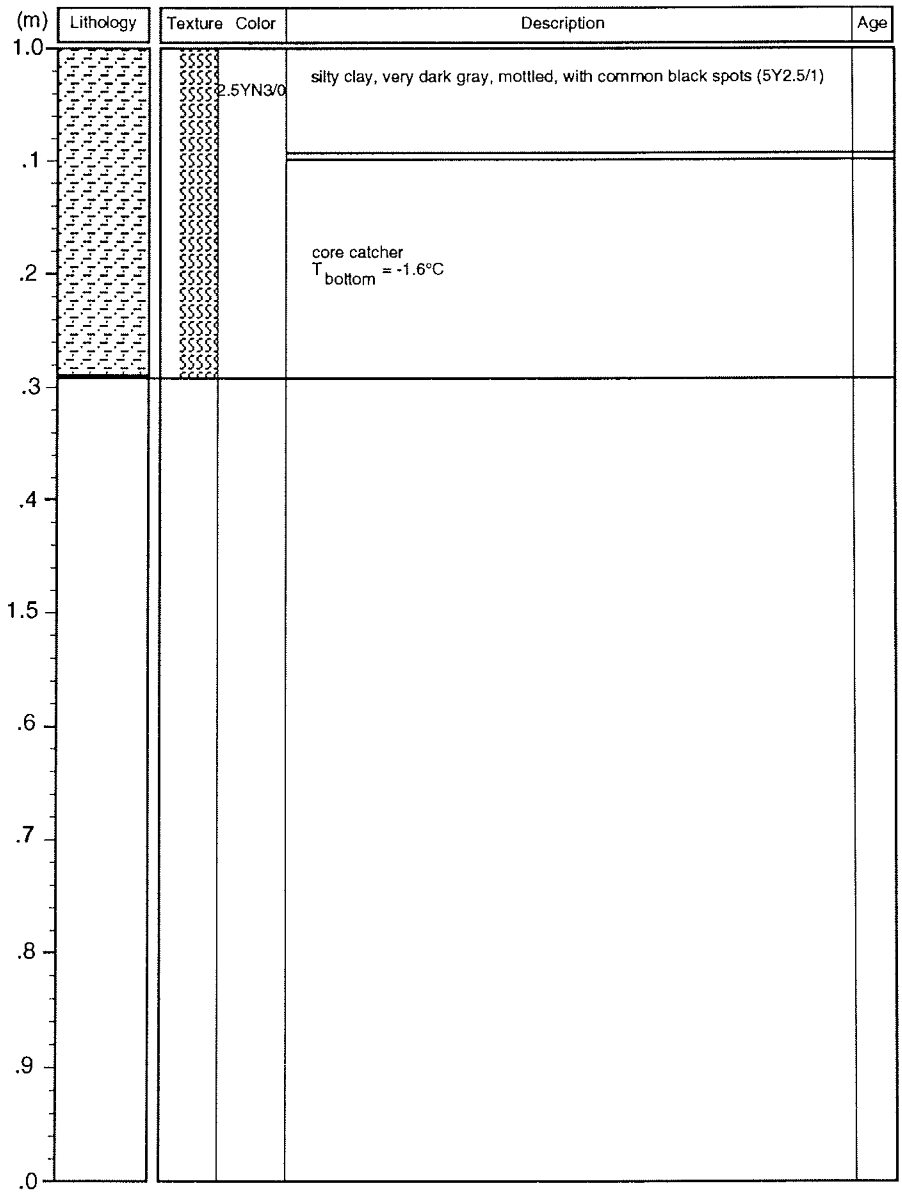


IK9373-10 (KL) LOC.: Southwest of Belkovsky island **TRANSDRIFT I**

Recovery: 1.09 m + 0.2 m CC 75°20.58´ N, 135°12. 29´E Water depth: 37 m



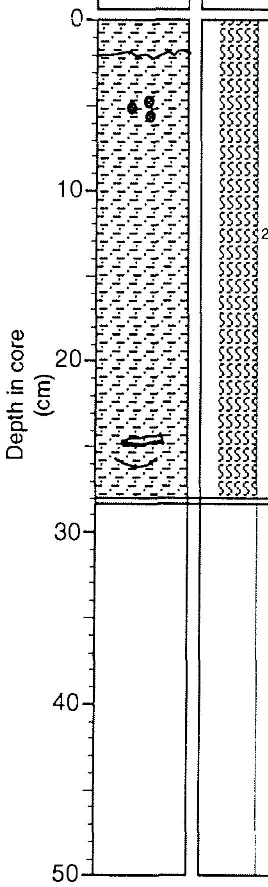
Color	Description	Age
2.5Y3/2	0-1 cm weakly silty clay, very dark greyish brown, rare bivalve shells	
2.5YN3/0	1-15 cm silty clay, very dark gray, mottled, down to 10 cm disturbed, rare worms and bivalves, rare bivalve shell fragments, rare black streaks (5Y2.5/1)	
2.5YN3/0	15-40 cm silty clay, very dark gray, weakly fine laminated, rare bivalve shell fragments, common black streaks (5Y2.5/1) open burrows at 16,19,23 and 29 cm	
2.5YN3/0	40-57 cm silty clay, very dark gray, mottled, rare bivalve shell fragments, rare black streaks (5Y2.5/1)	
2.5YN3/0	57-59 cm silty clay, very dark gray, weakly fine laminated, rare bivalve shell fragments, common black streaks (5Y2.5/1)	
2.5YN3/0	59-67 cm silty clay, very dark grey, mottled, rare bivalve shell fragments, rare black streaks (5Y2.5/1)	
2.5YN3/0	67-73 cm silty clay, very dark gray, mottled, rare bivalve shell fragments, rare black streaks (5Y2.5/1), open burrow at 69 cm (67-70 weakly fine laminated)	
2.5YN3/0	73-86 cm silty clay, very dark gray, mottled, rare bivalve shell fragments, rare black streaks (5Y2.5/1), burrows at 77 cm, open burrow at 83 cm	
2.5YN3/0	86-109 cm weakly silty clay, very dark gray, mottled, rare bivalve shell fragments (at 109 cm end of core)	


(m)
Lithology
Texture Color
Description
Age
1.0
.1
.2
.3
.4
1.5
.6
.7
.8
.9
.0
2.5YN3/0
silty clay, very dark gray, mottled, with common black spots (5Y2.5/1)
core catcher
T bottom = -1.6°C

IK9373-7 (KG) Loc.: Southwest of Belkovski island **TRANSDRIFT I**

Recovery: 0.28 m 75°20.56´ N, 135°09.32´ E Water depth: 47 m

Surface	silty clay, very dark grayish brown (2.5Y3/2), soft, mottled, patches of dark grains (up to fine sand), rare bivalve shell fragments



Lithology	Texture	Color	Description	Age
		2.5Y3/2	0-2 cm surface described above	
			5 cm burrows	
		2.5YN3/0	2-28 cm silty clay, very dark gray, mottled, with sand and clay lenses, black (5Y2.5/1) streaks, rare bivalve shell fragments	
			25 cm wood debris and shell fragments	
			end of core	

IK9373A-6 (KG) Loc.:West of Belkovsky island **TRANSDRIFT I**

Recovery: 0.31 m 75°48.66´ N, 134°35.03´ E Water depth: 46 m

T=-0.3°C

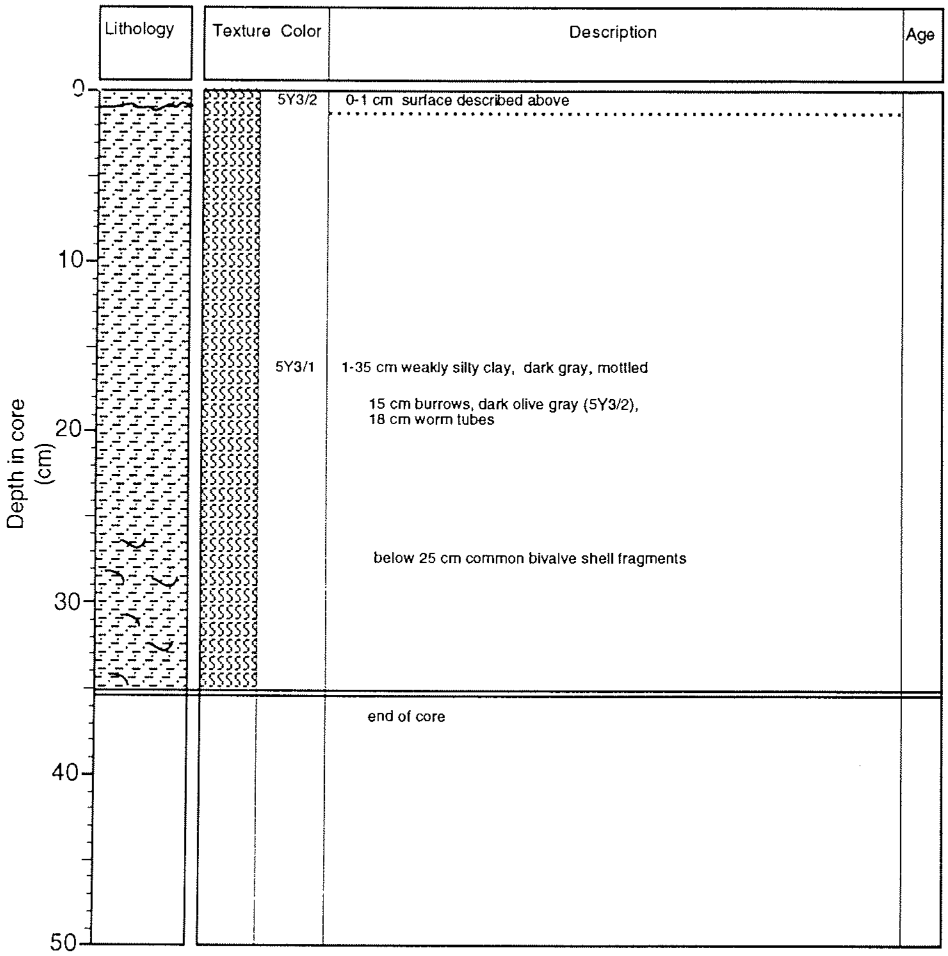
Surface silty clay, very dark greyish brown (2.5Y3/2), mottled, soft, rare amphipods

Depth in core (cm)	Lithology	Texture	Color	Description	Age
0			2.5Y3/2	0-2 cm surface described above	
10			5Y3/1	2-31 cm silty clay, very dark gray, mottled, with common black streaks and patches (5Y2.5/1)	
20				at 23 cm disrupted core	
				at 25-28 cm burrows with common mud clasts, gradual color changes to very dark greyish brown	
				at 23-31 cm common shell fragments	
30				end of core	
40					
50					

IK9381-3 (KG) Loc.: Northwest of Kotelnyy **TRANSDRIFT I**

Recovery: 0.35 m 76°31.64´ N, 133°18.73´ E Water depth: 38 m

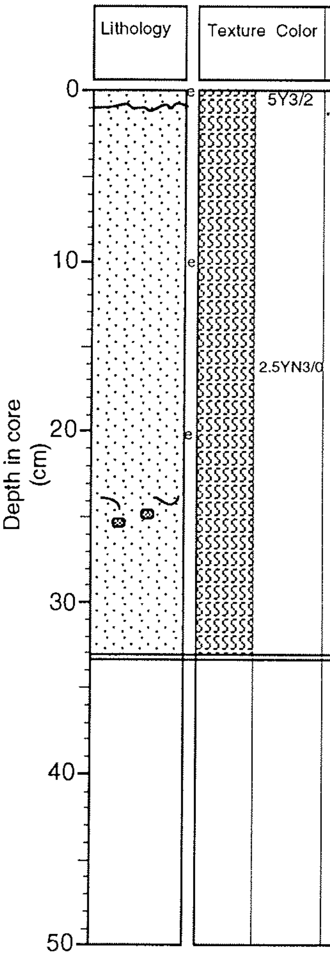
T= -1.3°C	
Surface	silty clay, dark olive gray (5Y3/2), soft, mottled



IK9382-7 (KG) Loc.: North of Kotelnyy island **TRANSDRIFT I**

Recovery: 0.33 m 76°30.26′ N, 137°15.39′ E Water depth: 25 m

Surface sandy silt, dark olive gray (5Y3/2)
worm tubes (Fe-Mn crusty), trace marks, rare
amphipods



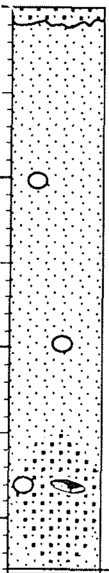
Description	Age
0-1 cm surface described above	
1-33 cm sandy silt, homogeneous with patchy sand and clay ey lenses gray (2.5YN4/0), black (2.5YRN2/0) and olive gray (5Y4/2) burrows, red (10R4/6) at 25 cm and shell fragments at 24 cm	
end of core	

IK9384-1 (KG) Loc.: Ice edge north of Kotelnyy **TRANSDRIFT I**

Recovery: 0.33 m 77°06.73´ N, 137°13.54´ E Water depth: 33 m

T=-1.8°C

Surface silty fine sand, very dark greyish brown (10 YR3/2), mud clasts (Ø cm-range) common brittle stars, rare worms, rare gastropods, rare holothurians, rare crustacea

Lithology	Texture	Color	Description	Age
		10YR3/2	0-1 cm surface described above	
			0-8 cm oxidized, crusted worm tube with soft biogenic inlay (crust=>yellowish red 5YR5/8)	
		5Y3/1	2-33 cm sandy silt, very dark gray, with irregular sand lenses	
			10-16 cm black patches (2.5YN2/0)	
			25-28 cm crusted worm tube with soft biogenic inlay (crust=>yellowish red 5YR5/8)	
			at 28 cm black mud clast with bivalve shell fragments (2cm Ø)	
			below 25 cm higher sand content	
			end of core	

Depth in core (cm): 0, 10, 20, 30, 40, 50

Tab. A4: Geological sampling and sedimentological analyses carried out during the TRANSDRIFT I expedition

Sediment core	Gear	Core Description	Photography	Smear slides	X-Ray	Surface: Temperature	Surface: Sedimentology	Surface: Paleontology	Surface: Trace Metals	Surface: PCB	Surface: Radionuclides (AARI)	Profile: Work Box (GEOMAR)	Profile: Archiv Box (GEOMAR)	Profile: Archiv Box (AWI)	Profile: Archiv (AARI)	Profile: Sedimentology	Profile: Physical Properties	Profile: PCB	Profile: Porewater	Waterpumping	Exceptionels	No Sampling	No Recovery
IK93 61-3	WP																			x			
IK93 61-7	BG																						x
IK93 61-8	BG																						x
IK93 61-9	KG	x	x	x	x	x	x					x	x	x			x				x		
IK93 61-10	KG							x	x	x	x								x		x		
IK93 61-11	KL																					x	
IK93 61-12	KL																					x	
IK93 Z2-2	WP																			x			
IK93 Z2-4	KG						x																
IK93 Z2-5	KG	x	x	x	x	x					x	x	x				x						
IK93 Z2-7	KG																						
IK93 Z2-8	KG							x	x	x				x				x	x				
IK93 26-1	WP																			x			
IK93 36-3	KG	x	x				x			x						x							
IK93 27-5	KG	x	x	x	x	x	x					x	x				x						
IK93 27-6	KG						x		x	x	x			x									
IK93 27-9	KL				x	x						x	x								x		
IK93 Z3-2	KG						x		x	x				x					x		x		
IK93 Z3-3	KG							x			x												
IK93 Z3-4	KG	x	x	x	x	x						x	x										
IK93 24-2	WP																			x			
IK93 24-3	KG				x	x	x				x	x	x										
IK93 24-4	KG							x	x	x				x					x				
IK93 24-5	KL	x	x		x	x						x	x								x		
IK93 38-4	KG	x	x	x	x	x	x	x				x	x								x		
IK93 38-5	KG							x	x	x	x			x									
IK93 38-8	KG														x				x				
IK93 38-9	D																				x		
IK93 40-5	KG	x	x	x	x	x	x				x	x	x										

Tab. A4: Geological sampling and sedimentological analyses carried out during the TRANSDRIFT I expedition

Sediment core	Gear	Core Description	Photography	Smear slides	X-Ray	Surface: Temperature	Surface: Sedimentology	Surface: Paleontology	Surface: Trace Metals	Surface: PCB	Surface: Radionuclides (AARI)	Profile: Work Box (GEOMAR)	Profile: Archiv Box (GEOMAR)	Profile: Archiv Box (AWI)	Profile: Archiv (AARI)	Profile: Sedimentology	Profile: Physical Properties	Profile: PCB	Profile: Porewater	Waterpumping	Exceptionels	No Sampling	No Recovery
IK93 40-6	KG							x	x	x				x									
IK93 40-9	KG				x										x								
IK93 42-1	WP																			x			
IK93 42-5	KG	x	x		x	x	x					x	x				x						
IK93 42-6	KG							x	x	x				x					x				
IK93 30-4	KG	x	x	x	x	x					x	x	x				x						
IK93 30-5	KG							x	x	x				x					x				
IK93 44-1	WP																			x			
IK93 44-8	KG							x	x		x				x				x				
IK93 44-9	KG									x				x				x					
IK93 44-10	KG	x	x	x	x	x	x					x	x										
IK93 44-11	KL																					x	
IK93 44-12	KL																					x	
IK93 44-13	D																				x		
IK93 46-4	KG							x		x					x								
IK93 46-5	KG			x			x			x						x							
IK93 48-5	KG	x	x		x	x	x					x	x				x						
IK93 48-6	KG						x	x		x	x			x									
IK93 48-7	KG						x																
IK93 48-8	KG														x								
IK93 49-6	KG										x								x				
IK93 49-7	KG	x	x		x	x	x			x		x	x	x							x		
IK93 49-8	KG														x								
IK93 34-5	KG														x						x		
IK93 34-6	KG	x	x		x	x	x				x	x	x				x						
IK93 34-7	KG							x	x	x				x									
IK93 34-10	KG	x	x	x	x	x						x	x										
IK93 34-11	D																				x		
IK93 23-1	WP																			x			

Tab. A4: Geological sampling and sedimentological analyses carried out during the TRANSDRIFT I expedition

Sediment core	Gear	Core Description	Photography	Smear slides	X-Ray	Surface: Temperature	Surface: Sedimentology	Surface: Paleontology	Surface: Trace Metals	Surface: PCB	Surface: Radionuclides (AARI)	Profile: Work Box (GEOMAR)	Profile: Archiv Box (GEOMAR)	Profile: Archiv Box (AWI)	Profile: Archiv (AARI)	Profile: Sedimentology	Profile: Physical Properties	Profile: PCB	Profile: Porewater	Waterpumping	Exceptionels	No Sampling	No Recovery
IK93 23-5	KG	x	x	x	x	x	x				x	x	x										
IK93 23-6	KG							x	x	x				x					x		x		
IK93 21-4	KG	x	x		x	x	x				x	x	x										
IK93 21-5	KG							x	x	x				x				x	x				
IK93 21-8	KL	x	x			x						x	x										
IK93 21-10	WP																			x			
IK93 20-1	KG						x	x							x								
IK93 20-2	KG	x	x			x				x		x	x	x									
IK93 18-1	KG				x					x				x									
IK93 18-5	KG	x	x			x	x	x			x	x	x				x						
IK93 18-7	KL																						x
IK93 13-6	KG							x			x										x		
IK93 13-7	KG	x	x	x	x	x	x			x		x	x	x			x						
IK93 13-8	KG														x								
IK93 13-9	KG																				x		
IK93 15-1	KG							x		x	x			x	x								
IK93 15-2	KG	x	x	x	x	x	x					x	x				x						
IK93 15-3	KL																					x	
IK93 15-4	KL																					x	
IK93 16-6	KG				x			x	x	x	x			x				x	x				
IK93 16-7	KG																						
IK93 16-8	KG	x	x			x	x					x	x				x						
IK93 16-9	KL	x	x									x	x				x				x		
IK93 16-11	WP																			x			
IK93 Z4-2	WP																			x			
IK93 Z4-3	KG	x	x	x	x	x	x				x	x	x				x				x		
IK93 Z4-4	KG							x	x	x				x				x	x				
IK93 Z4-5	KL																					x	
IK93 06-5	KG	x	x	x	x	x	x				x	x	x								x		

Tab. A4: Geological sampling and sedimentological analyses carried out during the TRANSDRIFT I expedition

Sediment core	Gear	Core Description	Photography	Smear slides	X-Ray	Surface: Temperature	Surface: Sedimentology	Surface: Paleontology	Surface: Trace Metals	Surface: PCB	Surface: Radionuclides (AARI)	Profile: Work Box (GEOMAR)	Profile: Archiv Box (GEOMAR)	Profile: Archiv Box (AWI)	Profile: Archiv (AARI)	Profile: Sedimentology	Profile: Physical Properties	Profile: PCB	Profile: Porewater	Waterpumping	Exceptionels	No Sampling	No Recovery
IK93 06-6	KG							x	x	x				x				x					
IK93 06-10	KG														x				x				
IK93 06-11	KL											x	x								x		
IK93 06-13	WP																			x			
IK93 Z5-1	WP																			x			
IK93 Z5-3	KG							x	x	x	x			x				x					
IK93 Z5-4	KG	x	x	x	x	x	x					x	x				x						
IK93 Z5-5	KG														x				x				
IK93 01-5	KG	x	x		x	x	x				x	x	x							x			
IK93 01-6	KG							x	x	x				x									
IK93 09-1	WP																			x			
IK93 09-2	KG	x	x	x	x	x	x				x	x	x				x						
IK93 09-3	KG																					x	
IK93 09-4	KG							x		x				x					x				
IK93 09-5	SL											x											
IK93 09-6	KL	x	x	x		x						x	x								x		
IK93 07-1	WP																			x			
IK93 07-3	KG	x	x		x	x	x		x	x	x	x	x	x			x	x					
IK93 81-3	KG	x	x		x	x	x			x		x	x				x		x				
IK93 73A-6	KG	x	x		x	x	x	x		x	x	x	x	x			x						
IK93 82-4	KG				x		x				x	x	x				x						
IK93 82-6	KG							x	x	x				x					x				
IK93 82-7	KG	x	x			x																	
IK93 82-8	D																				x		
IK93 50-6	KG							x	x	x	x			x					x				
IK93 50-7	KG	x	x		x	x	x					x	x				x						
IK93 50-10	KL	x	x									x	x				x				x		
IK93 53-2	WP																			x			

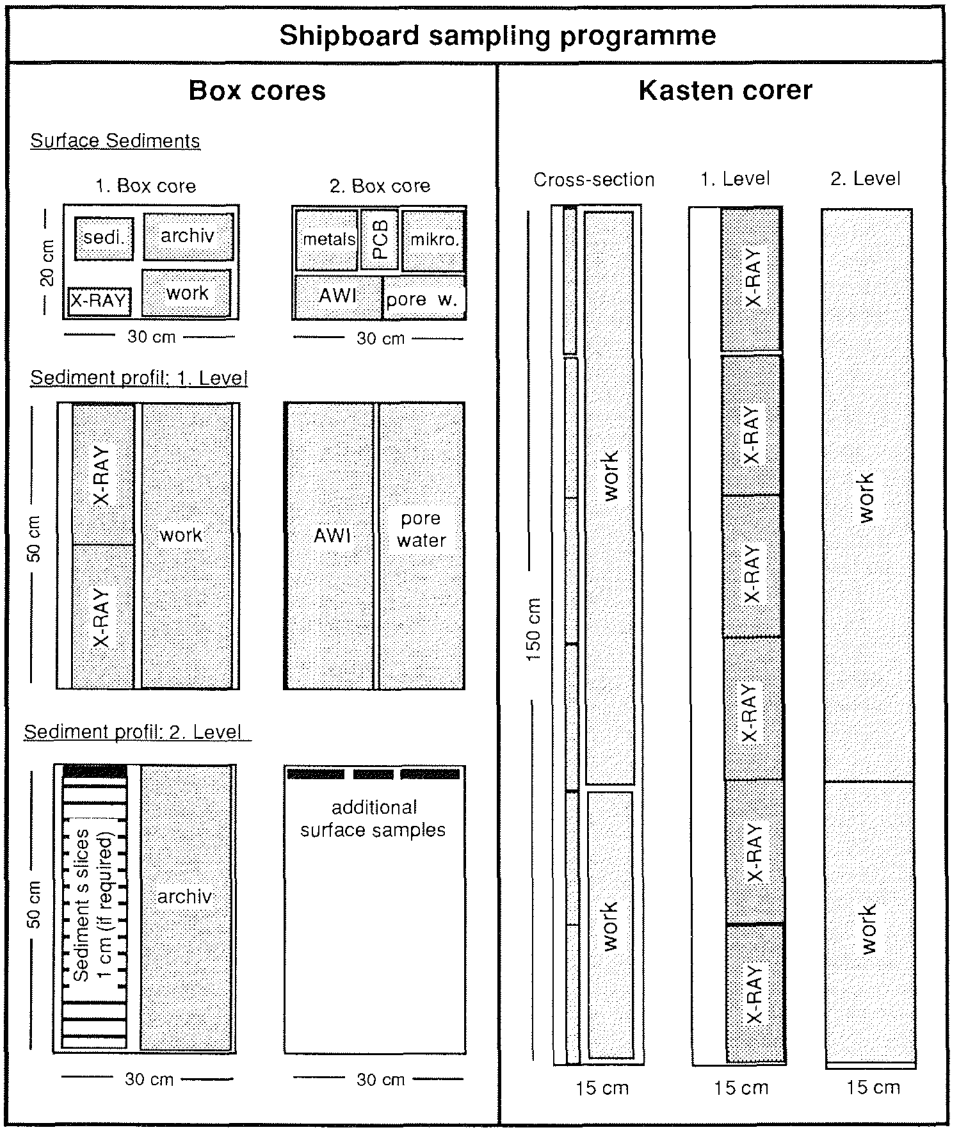
Tab. A4: Geological sampling and sedimentological analyses carried out during the TRANSDRIFT I expedition

Sediment core	Gear	Core Description	Photography	Smear slides	X-Ray	Surface: Temperature	Surface: Sedimentology	Surface: Paleontology	Surface: Trace Metals	Surface: PCB	Surface: Radionuclides (AARI)	Profile: Work Box (GEOMAR)	Profile: Archiv Box (GEOMAR)	Profile: Archiv Box (AWI)	Profile: Archiv (AARI)	Profile: Sedimentology	Profile: Physical Properties	Profile: PCB	Profile: Porewater	Waterpumping	Exceptionels	No Sampling	No Recovery
IK93 53-8	KG	x	x		x	x	x				x	x	x				x						
IK93 53-9	KG							x	x	x				x				x	x				
IK93 53-12	KL																						x
IK93 56-1	KG	x	x		x	x	x					x	x								x		
IK93 56-2	KG							x		x				x					x				
IK93 58-5	KG	x	x		x	x	x				x	x	x				x				x		
IK93 58-6	KG							x	x	x				x					x				
IK93 58-9	KL																						x
IK93 58-10	KL																					x	
IK93 60-1	WP																			x			
IK93 65-6	KG							x		x	x			x					x		x		
IK93 65.8	KG	x	x		x	x	x					x	x										
IK93 65-10	SL																					x	
IK93 67-1	KG	x	x		x	x	x				x	x	x				x						
IK93 67-2	KG							x		x				x					x				
IK93 68-6	KG							x		x	x			x					x				
IK93 68-8	KG	x	x		x	x	x					x	x				x						
IK93 68-10	SL																					x	
IK93 70-1	WP																			x			
IK93 70-6	KG	x	x		x	x	x				x	x	x				x				x		
IK93 70-7	KG							x	x					x				x	x				
IK93 70-8	KG																				x		
IK93 71-1	KG							x		x	x			x									
IK93 71-2	KG																					x	
IK93 71-3	KG	x	x				x					x	x										
IK93 73-6	KG																				x		
IK93 73-7	KG	x	x		x	x	x				x	x	x				x						
IK93 73-8	KG							x		x				x									

Tab. A4: Geological sampling and sedimentological analyses carried out during the TRANSDRIFT I expediti[redacted]

Sediment core	Gear	Core Description	Photography	Smear slides	X-Ray	Surface: Temperature	Surface: Sedimentology	Surface: Paleontology	Surface: Trace Metals	Surface: PCB	Surface: Radionuclides (AARI)	Profile: Work Box (GEOMAR)	Profile: Archiv Box (GEOMAR)	Profile: Archiv Box (AWI)	Profile: Archiv (AARI)	Profile: Sedimentology	Profile: Physical Properties	Profile: PCB	Profile: Porewater	Waterpumping	Exceptionels	No Sampling	No Recovery
IK93 73-10	KL	x	x		x	x						x	x								x		
IK93 K1-1	KG	x	x		x	x	x	x				x	x	x									
IK93 84-1	KG	x	x		x	x	x	x			x	x	x	x									
IK93 K2-1	KG	x	x		x		x	x				x	x	x									
IK93 80-1	WP																			x			

Tab. A5: Shipboard geological sampling programme of the TRANSDRIFT I expediton



Tab. A6: Results of smear slide analyses carried out on board "Ivan Kireyev"

Sample	Diatoms	Feldspar	Foraminifers	Heavy minerals	Mica	Nannofossils	Plant debris	Qartz	Rock fragments	Sponge spicules	Additional biogenic components
IK93Z2-5											
surface (I)	-	C	-	A	-	-	C	D	T	-	C
surface (II)	-	C	-	A	-	T	C	D	T	T	C
5 cm (I)	-	C	-	C	R	T	-	D	R	-	R
5 cm (II)	-	C	-	C	R	T	-	D	R	-	R
15 cm (I)	-	C	-	C	-	-	C	D	T	-	C
15 cm (II)	-	C	-	C	-	-	C	D	T	-	C
IK9361-9											
surface	-	C	-	R	-	-	-	D	T	C	C
5 cm	-	R	-	T	R	-	-	D	T	R	R
10 cm	-	C	-	T	-	T	-	D	-	T	R
15 cm	-	R	-	R	-	T	-	D	-	-	R
20 cm	-	R	-	R	-	-	-	D	T	-	T
25 cm	-	C	-	T	-	T	-	D	-	-	R
IK93Z3-4											
surface (I)	-	R	-	C	-	T	R	D	R	R	R
surface (II)	-	R	-	C	-	T	R	D	R	-	R
5 cm	-	R	-	C	-	R	-	D	R	-	R
15 cm	-	T	-	R	-	R	-	D	R	-	R
25 cm	-	R	-	C	-	R	-	D	R	-	R
IK9327-5											
surface (I)	-	C	-	C	-	-	-	D	-	-	T
surface (II)	-	C	-	C	-	-	-	D	R	-	T
5 cm	-	C	-	C	-	-	-	D	C	-	T
10 cm	-	R	-	R	-	-	-	D	-	R	R
15 cm	T	R	-	C	-	-	-	D	-	-	T
20 cm	R	C	-	R	-	-	-	D	R	-	R
25 cm	R	C	-	C	-	-	-	D	-	R	R
IK 9338-4											
surface (I)	T	C	-	R	-	-	-	D	-	-	R
surface (II)	R	R	-	T	-	-	-	D	-	R	C
5 cm	T	R	-	T	-	T	-	D	-	T	R
15 cm	T	R	-	T	-	T	-	D	-	T	R
25 cm	R	R	-	R	-	T	-	D	-	R	R
30 cm	R	C	-	R	-	T	-	D	-	R	C
38 cm burrow	T	R	-	T	-	T	-	D	-	-	T
IK9340-5											
surface	C	R	-	T	-	-	-	C	-	-	C
5 cm	C	T	-	T	-	-	-	C	-	R	C
8 cm	C	R	-	C	-	-	-	A	-	T	C
13 cm	C	R	-	R	-	-	-	A	-	T	C
IK9330-4											
surface	C	R	-	R	-	-	R	A	-	-	C
15 cm	R	R	-	C	-	-	T	A	-	-	R
33 cm	R	T	-	R	-	-	-	D	-	-	R

Sample	Diatoms	Feldspar	Foraminifers	Heavy minerals	Mica	Nannofossils	Plant debris	Qartz	Rock fragments	Sponge spicules	Additional biogenic components
IK9344-10											
surface	R	T	-	R	-	-	-	D	-	-	R
5 cm	T	T	-	T	-	T	-	D	-	-	T
20 cm	T	R	-	R	-	-	R	D	-	-	T
IK9346-5											
surface	R	R	-	C	-	-	-	D	C	-	R
4 cm	R	C	-	C	-	-	-	D	C	-	R
IK9323-5											
surface	R	C	-	C	C	-	C	D	C	R	C
3 cm	R	R	-	C	C	-	C	D	R	-	C
5.5 cm	C	R	-	C	R	-	R	D	C	R	C
9 cm	C	R	-	C	C	-	C	A	C	T	C
12 cm	C	T	-	C	T	-	R	D	C	T	C
17 cm burrow	C	T	-	C	T	-	R	D	-	-	C
21 cm	R	T	-	C	-	-	R	D	-	-	R
27 cm	R	R	-	C	-	-	R	D	R	-	R
IK9334-10											
15 cm	T	T	-	C	T	-	T	D	T	-	R
34 cm	R	T	-	R	R	-	-	D	-	-	R
40 cm	R	T	-	R	T	-	T	D	-	-	R
60 cm	T	T	-	R	C	-	-	D	-	-	T
80 cm		R	-	C	R	-	T	D	-	-	T
90 cm	T	R	-	C	-	-	T	D	-	-	C
100 cm	T	R	-	C	R	-	-	D	-	-	T
IK9309-2											
surface	C	R	-	C	R	-	C	D	R(co)	-	C
10 cm burrow	C	R	T	C	R	-	C	D	R(co)	T	C
20 cm	C	C	-	C	R	-	C	D	R(co)	T	C
IK9309-6											
10 cm	C	R	T	C	C	-	C	D	R(co)	-	C
30 cm	R	C	-	C	C	-	R	D	R(co)	-	R
50 cm	R	R	T	C	C	-	T	D	R(co)	T	R
70 cm	T	R	-	C	C	T	T	D	R(co)	T	R
90 cm	T	C	T	C	C	-	-	D	R(co)	-	T
100 cm	-	R	-	R	C	T	R	D	R(co)	-	R
110 cm	R	R	-	R	C	-	R	D	R(co)	-	R
120 cm	R	C	-	R	R	-	R	D	R(co)	-	R
148 cm	T	C	-	C	C	T	C	D	R(co)	-	C
IK9315-2											
surface	R	R	T	C	R	T	T	A	T(co)	-	R
IK9313-7											
surface	T	C	T	C	R	T	T	A	T(co)	-	R
12 cm	-	C	-	C	T	T	R	A	T(co)	-	R
IK9306-5											
surface	R	R	-	C	C	-	T	D	R(co)	R	R

Sample	Diatoms	Feldspar	Foraminifers	Heavy minerals	Mica	Nannofossils	Plant debris	Qartz	Rock fragments	Sponge spicules	Additional biogenic components
15 cm	T	T	T	C	C	-	R	D	T(co)	T	R
31 cm	T	T	-	C	C	-	-	D	R(co)	-	R
IK93Z4-3											
surface	C	R	T	C	C	T	R	D	T(co)	-	C
15 cm	R	R	T	C	C	T	R	D	T(co)	-	R
IK93Z5-4											
surface	T	R	T	C	R	T	R	D	T(co)	-	R
2 cm	T	C	T	C	R	T	R	D	T	-	R
10 cm	T	R	T	C	R	T	T	D	T	-	R
15 cm	R	R	T	C	T	T	R	D	T(co)	T	R
IK9356-1											
surface	R	C	T	C	R	T	-	D	T(co)	T	R
10 cm	R	R	T	C	T	T	-	D	T(co)	-	R
IK9353-8											
5 cm	R	R	-	C	T	T	-	D	T(co)	-	R
32 cm	-	R	T	C	R	T	T	D	T(co)	-	T
IK9382-7											
surface	T	C	R	C	R	T	T	D	-	-	R
10 cm	R	C	-	C	T	T	-	D	-	-	R
20 cm	T	C	T	C	R	T	T	D	-	-	T
IK9370-6											
surface	C	R	-	R	R	T	-	D	-	-	C
15 cm	T	T	-	R	R		-	D	-	-	T
37 cm	R	R	T	C	R	T	-	D	-	-	R
IK9367-1											
surface	R	R	T	C	C	T	T	D	R(co)	-	R
10 cm	C	T	-	R	C	T	T	D	-	-	C
32 cm	R	T	T	R	R	T	-	D	-	-	R
IK9368-8											
surface	R	T	-	R	T	-	-	D	T(co)	-	R
15 cm	C	T	-	R	T	-	-	D	T(co)	-	C
30 cm	R	R	-	C	C	-	A	D	R(co)	-	A

T= traces R=rare C=common A=abundant D=dominant co=coal