H – Fahrtbericht der Sommerexpeditionen TRANSDRIFT XII, XIV und XVI

Russian-German Cooperation
Laptev-Sea System

Expeditions TRANSDRIFT XII, XIV and XVI
Summer 2007, 2008, 2009

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ABBREVIATIONS AND ACRONYMS

AARI	State Research Center – Arctic and Antarctic Research Institute
ADCP	Acoustic Doppler Current Profiler
AFM	Carousel Autofire Module
AWI	Alfred Wegener Institute for Polar and Marine Research
DOM	Dissolved organic matter
CDOM	Chromophoric dissolved organic matter
CTD	Conductivity Temperature Depth Meter
IFM-GEOMAR	Leibniz Institute of Marine Sciences
IPY	International Polar Year
IRD	Ice-rafted debris
MODIS	Moderate Resolution Imaging Spectroradiometer
MVD	Multioperational Vibrocoring Device
OSL	Otto Schmidt Laboratory for Polar and Marine Research
POMOR	Master Program for Applied Polar and Marine Sciences
PSU	Practical Salinity Units
RAS	Russian Academy of Sciences
SCOUTS	Satellite connected oceanographic up-turning transmitting system
SLP	Sea-level pressure
SPM	Suspended Particulate Matter

I. THE SUMMER EXPEDITIONS TRANSDRIFT XII, XIV, AND XVI

Over the past decades it has become evident that the Arctic is undergoing significant and sweeping changes, this being the reason of increasing concern. In the past 30 years the average ice cover during summer has decreased by up to 40% and an even more rapid decrease is predicted for the near future. Particularly drastic changes are expected for the seasonally ice-covered circumarctic shelf seas. Here the so-called polynyas, open water areas forming along the arctic coasts between fast and drift ice during the winter months, play an important role in sea ice formation and the ecosystem of the shelf seas. These polynyas strongly and rapidly react to changes in oceanic and atmospheric circulation and, therefore, can serve as a model example for investigating the response of the Arctic to regional and circumarctic changes.

The Russian-German project "Laptev Sea System: the Eurasian Shelf Seas in the Arctic's Changing Environment – Frontal Zones and Polynya Systems in the Laptev Sea" is carried out by the Arctic and Antarctic Research Institute (AARI, St. Petersburg), the Leibniz Institute of Marine Sciences (IFM-GEOMAR, Kiel), the Alfred Wegener Insitute of Polar and Marine Research (AWI, Bremerhaven), the Mainz Academy of Sciences, Humanities and Literature and the University of Trier in order to study polynya and oceanic front systems of the Laptev Sea. The project is directly connected with the Russian partner project "Laptev Sea System: Frontal Zones and Polynya Systems in the Laptev Sea" and is included in the Russian IPY project "Complex Investigations of Seasonal Cycle in the Arctic Seas" with the expeditions BARKALAV-2007 and 2008, both funded by the Russian Ministry of Education and Research and carried out with the AARI as leading institute. In addition it is an integral part of the international science plan for the Arctic, ICARP II.

The project focuses on the response of front and polynya systems on climate changes and feedback mechanisms affecting global climate. For this purpose measurements of oceanographic and biogeochemical parameters were carried out for a period of two years with the use of seafloor observatories as well as remote sensing data and field experiments during all seasons of the year. The resulting multidisciplinary datasets are fed into ice/ocean models in order to be able to provide realistic prognoses on polynya activities. An essential part of the research is provided by historical data from the polynya region as background for assessing current changes.

At the center of the research were five expeditions to the Laptev Sea: the two winter expeditions TRANSDRIFT XIII in 2008 and TRANSDRIFT XV in 2009, and the three summer expeditions TRANSDRIFT XII in 2007, TRANSDRIFT XIV in 2008 and TRANSDRIFT XVI in 2009. The overall goal of these field studies was to obtain data from all the seasons of the year.

The main aim of the summer expeditions was to deploy (2007), to check and re-deploy (2008) and to recover (2009) seafloor observatories. These seafloor observatories were to provide continuous measurements of oceanographic and biogeochemical parameters for a period of two years. In addition, oceanographic, hydrochemical, biological and sedimentological studies were carried out in the polynya area during three subsequent years. For the positions of the seafloor observatories as well as the stations of the summer expeditions see Figure 1.

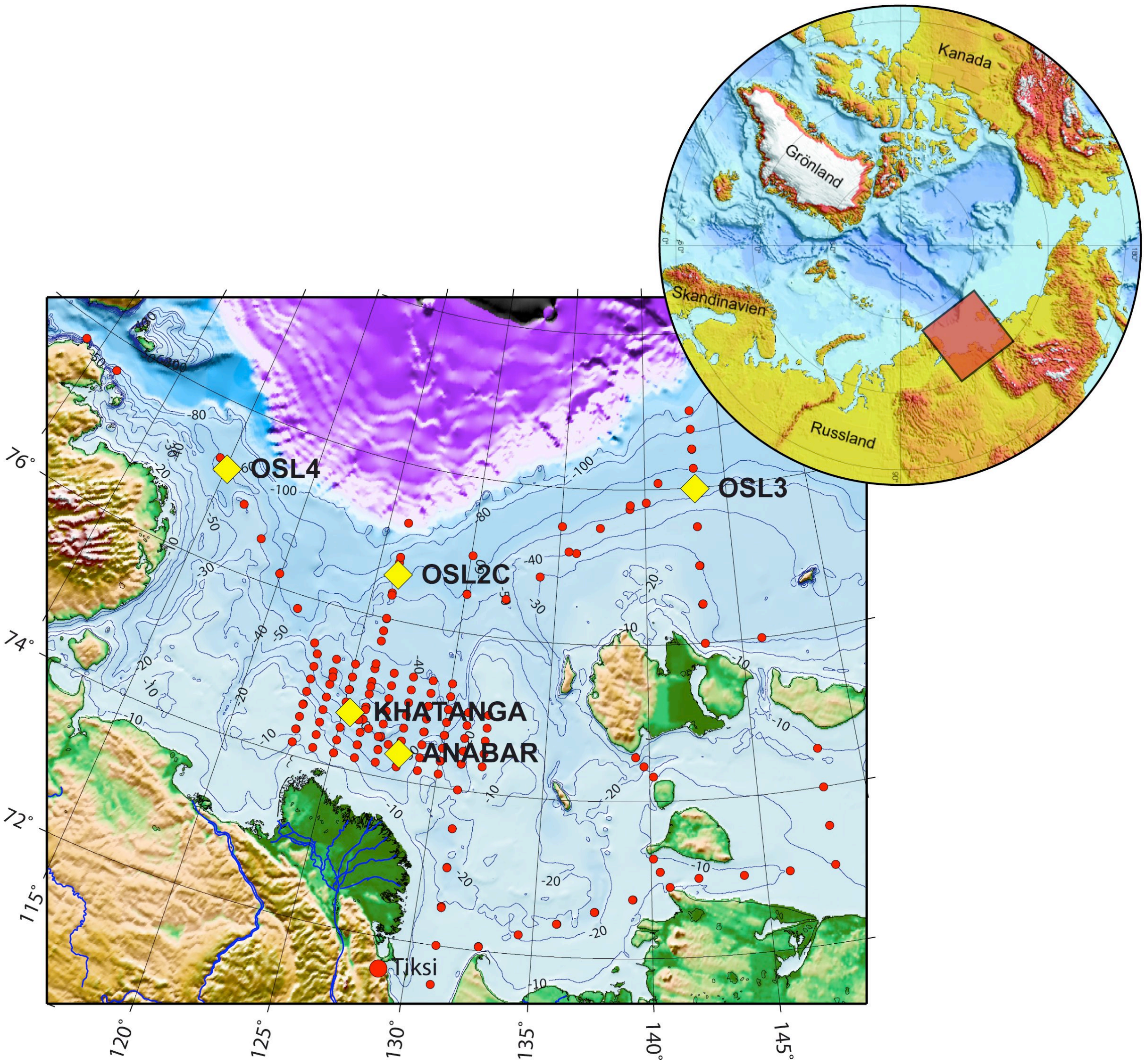
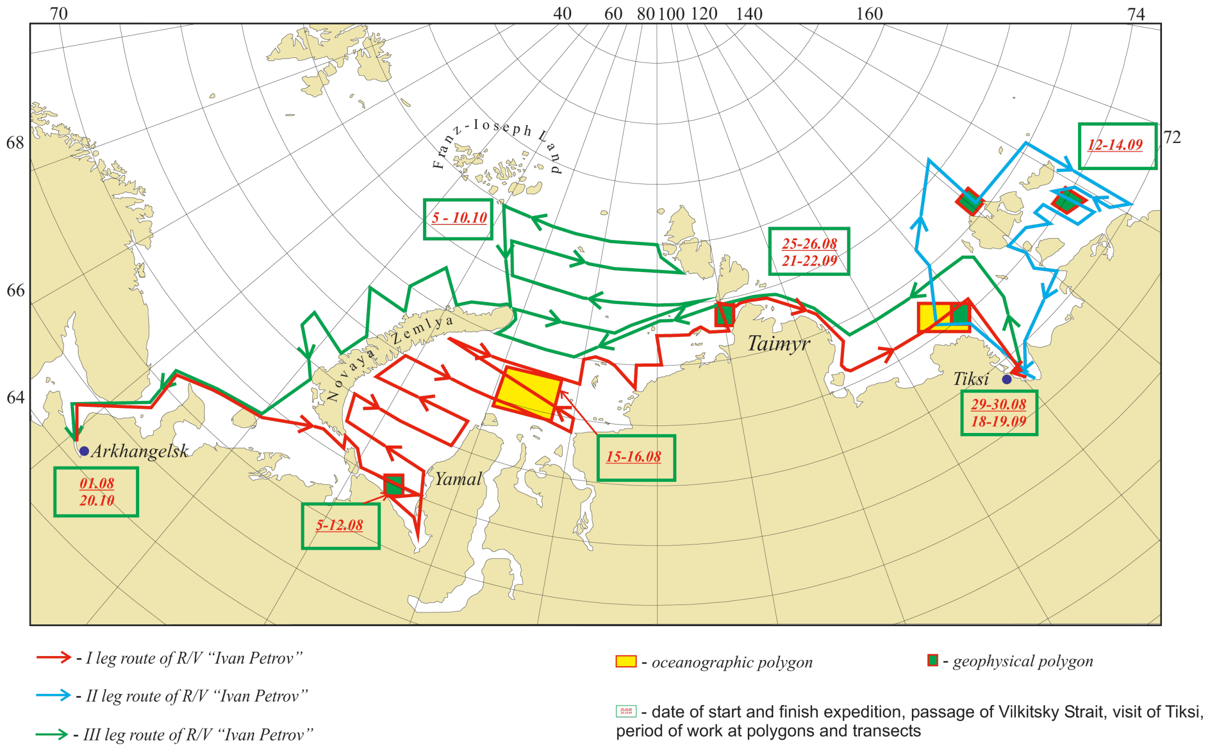


Fig. 1: Stations of the summer expeditions TRANSDRIFT XII, XIV and XVI (red dots) with positions of the seafloor observatories KHATANGA, ANABAR, OSL2C, OSL3 and OSL4 (yellow diamonds).

The TRANSDRIFT XII expedition took place from August 22 to September 22, 2007, as a leg of the Russian IPY expedition BARKALAV-2007 (August 2 to November 9, 2007; Fig. 2). The vessel used for the expedition was RV “Ivan Petrov” (Fig. 3). 105 stations were carried out. The research team consisted of 25 scientists from the AARI, AWI, Bremen University, IFM-GEOMAR, Mainz Academy of Sciences, Humanities and Literature, P.P. Shirshov Institute of Oceanology RAS (Moscow), State Lena Delta Reserve, St. Petersburg State University (in cooperation with the Master Program for Applied Polar and Marine Science POMOR) and VNIIOkeangeologia (St. Petersburg).



Route of R/V "Ivan Petrov" in 2007 during the BARKALAV expedition

Fig. 2: The route of RV „Ivan Petrov“ during the Russian IPY expedition BARKALAV-2007 in the Kara, Laptev and East Siberian seas (August 2 to November 9, 2007).

Fig. 3: Left: RV "Yakov Smirnitsky" (Hydrobase Arkhangelsk), constructed in Finland in 1977, length 69 m; research vessel of the expedition TRANSDRIFT XVI. Right: RV "Ivan Petrov" (Rosgidromet), constructed in Finland in 1984, length 49 m; research vessel of the expeditions TRANSDRIFT XII and XIV.

The TRANSDRIFT XIV expedition took place from September 5 to 21, 2008, as a leg of the Russian IPY expedition BARKALAV-2008 (August 3 to October 30, 2008; Fig. 4), also onboard RV "Ivan Petrov". 92 stations were carried out in the Laptev and East Siberian seas. The research team consisted of 14 scientists from the AARI, AWI, IFM-GEOMAR, P.P. Shirshov Institute of Oceanology, St. Petersburg State University (in cooperation with POMOR), and the State Lena Delta Reserve.

The TRANSDRIFT XVI expedition took place from August 31 to September 19, 2009. The vessel used for the expedition was RV "Yakov Smirnitsky" (Fig. 3). 43 stations were carried out. The research team consisted of 10 scientists from AARI, IFM-GEOMAR, St. Petersburg State University (in cooperation with POMOR), and the State Lena Delta Reserve.

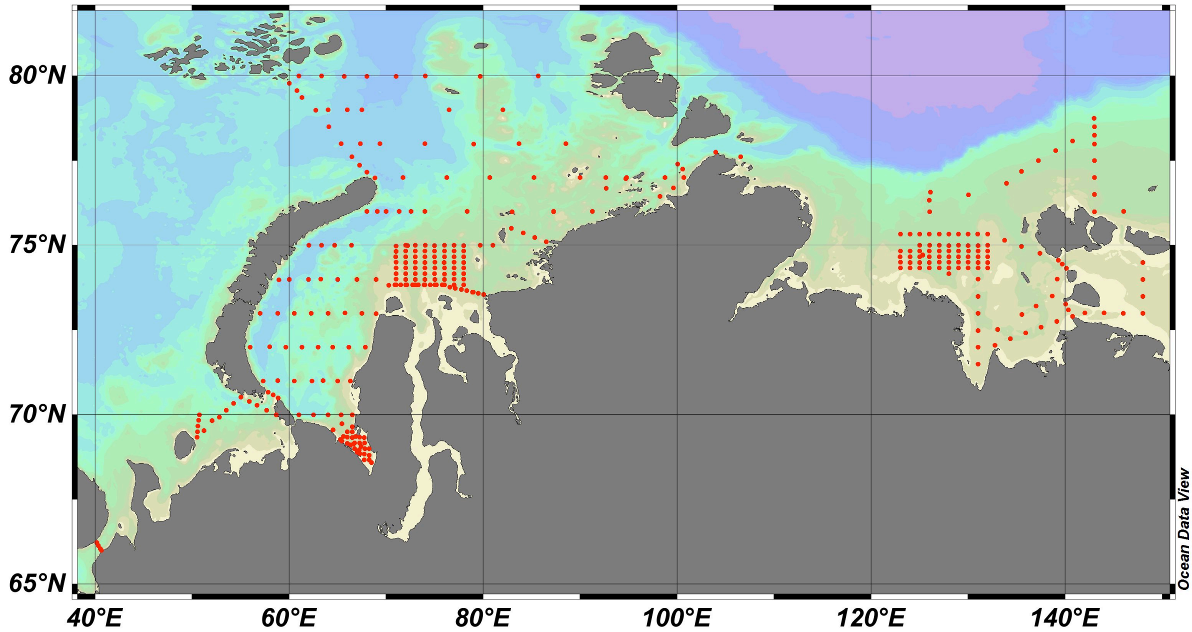


Fig. 4: Stations of the Russian IPY expedition BARKALAV-2008 in the Kara, Laptev and East Siberian seas (August 3 to October 30, 2008).

The expeditions were funded by the German Ministry of Education and Research (FKZ 03G0639), the Russian Ministry for Education and Science (IPY BARKALAV), AARI, AWI, IFM-GEOMAR, OSL and the German Academic Exchange Service (DAAD). We would like to thank these organizations for their financial and logistic support.

The working programs as well as preliminary results of the three expeditions are presented below.

II. CRUISE REPORTS

II.1 TRANSDRIFT XII

The TRANSDRIFT XII expedition to the Laptev Sea was carried out onboard RV „Ivan Petrov“ (www.sevmeteo.ru/ecimo/expedition/petrov.shtml) from August 22 to September 22, 2007. The expedition comprised a leg of the Russian 3-month IPY expedition BARKALAV. 25 scientists from Russia, the Ukraine and Germany as well as 15 crew members took part in the expedition (see Appendix „Lists of participating institutions and scientists“).

The aim of the expedition was to deploy two seafloor observatories in the area of the Laptev Sea polynya as well as to carry out concise oceanographic, hydrochemical, biological and sedimentological measurements. Of particular importance was the use of probes for high-resolution (in cm) measurements of oxygen, chlorophyll *a* and suspended particulate matter in the water column. A high-resolution measuring grid north of the Lena Delta (Fig. 5) together with high vertical resolution of the sensors allowed obtaining a detailed 3-dimensional scheme of the oceanographic structures. Combined with remote sensing data (MODIS) for the large-scale distribution of chlorophyll *a*, yellow substances and suspended matter in the surface layer of the Laptev Sea, the measurements for the first time provided a deep insight into this complex environmental system.

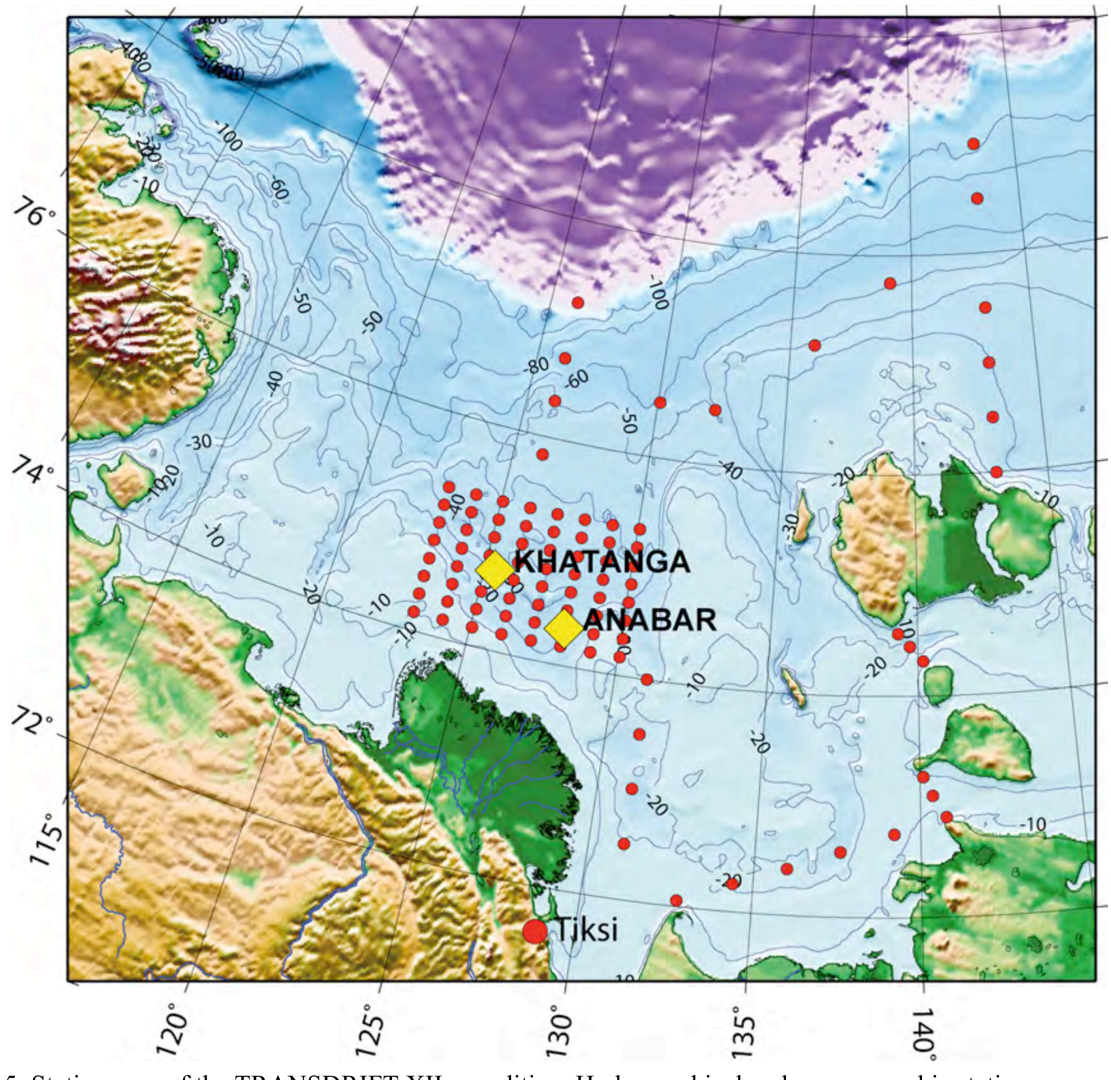


Fig. 5: Station map of the TRANSDRIFT XII expedition. Hydrographical and oceanographic stations are marked red, while deployment and recovery of the seafloor observatories are marked yellow.

Although the weather conditions were quite severe and storms and rough seas interrupted the working program for several days (Fig. 6), 96 stations were carried out in the Laptev and East Siberian seas (Fig. 5). Two oceanographic seafloor observatories, deployed in 2005 and 2006, were recovered, and two seafloor observatories were deployed for one year.

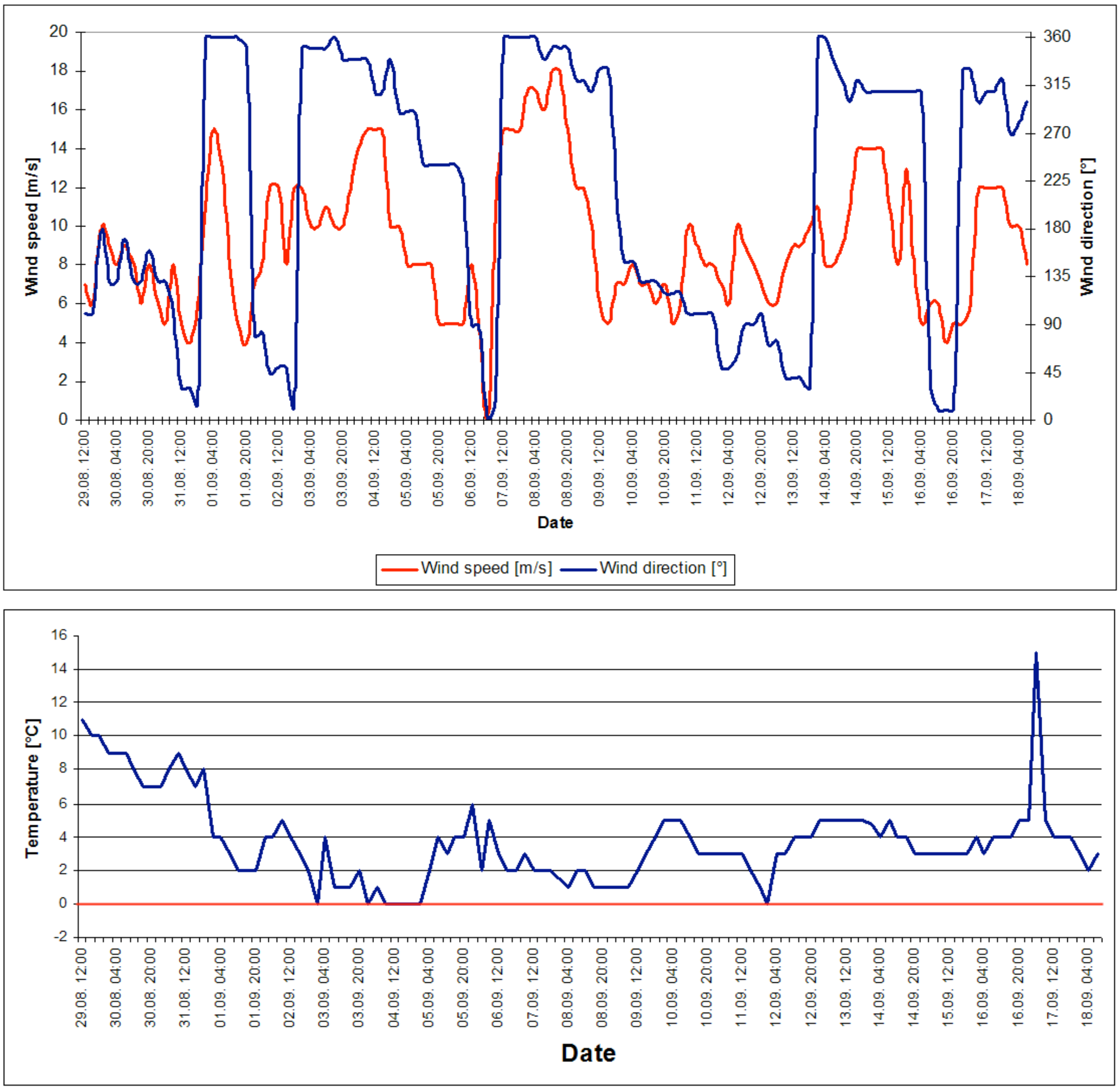


Fig. 6: Upper panel: wind speed and wind direction, measured with the ship's meteorological equipment between August 29 and September 18, 2007; lower panel: air temperature, measured with the ship's meteorological equipment between August 29 and September 18, 2007.

The international expedition NABOS 2007 and the other legs of the Russian BARKALAV expedition to the Kara Sea considerably increased the scope of the field measurements for the summer season. Their data together with the obtained datasets of TRANSDRIFT XII are of extremely high importance for evaluating the changes in the Arctic ecosystem, in particular against the background of the record decrease in the ice cover of the Arctic Ocean in 2007 (Fig. 7) and of the current debate on the dramatic climate changes in the Arctic.

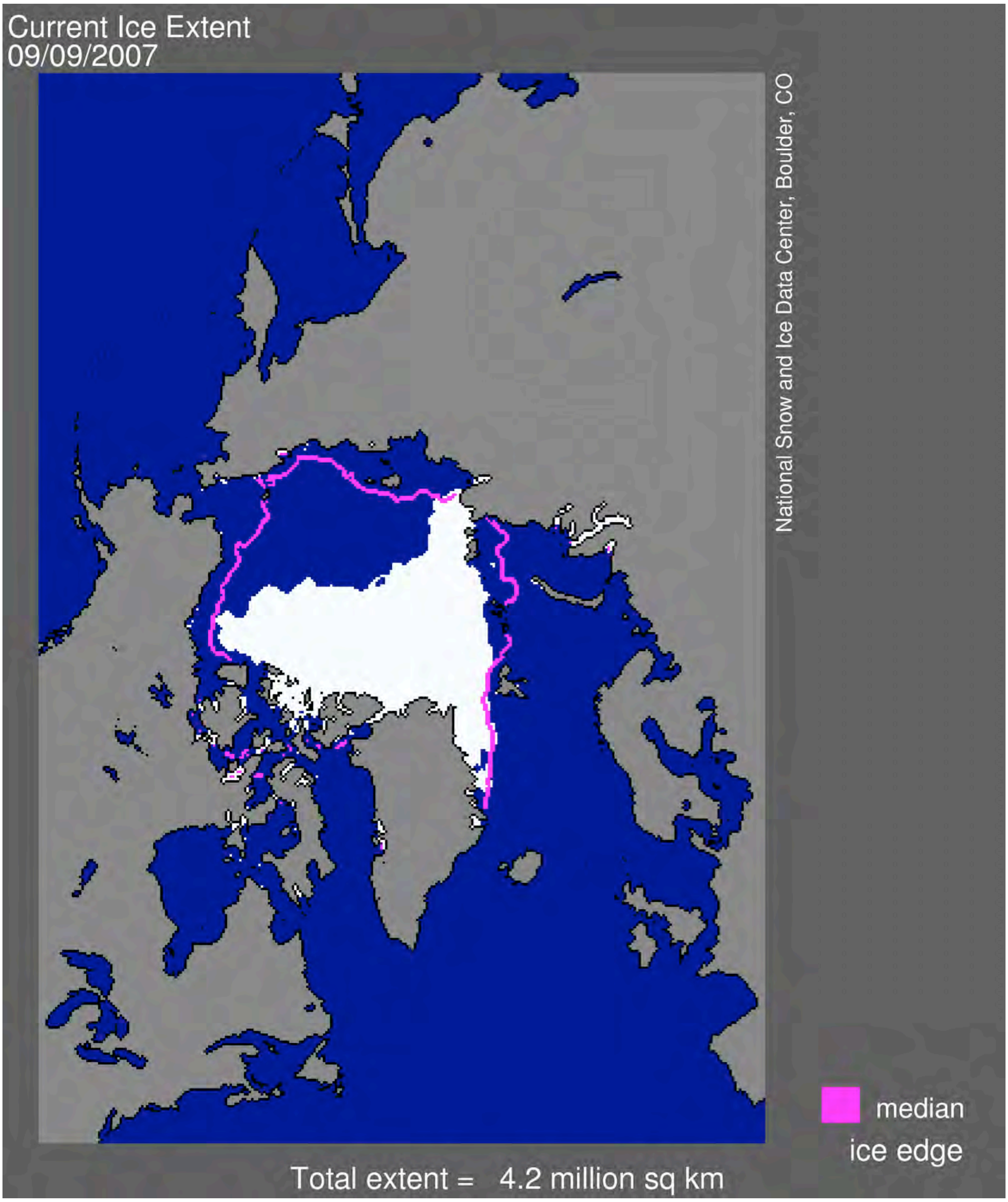


Fig. 7: Sea ice extent for September 16, 2007. The magenta line shows the median September monthly extent based on data from 1979 to 2000. Arctic sea ice during the 2007 melt season reached the lowest levels since satellite measurements began in 1979. The average sea ice extent for the month of September was 4.28 mill. km^2, the lowest September on record. At the end of the melt season September 2007, sea ice was 39% below the long-term average from 1979 to 2000.

Oceanographic investigations

S. Kuz'min[1], L. Ermakova[2], T. Klagge[3], J. Hoelemann[4]

[1]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[2]P.P. Shirshov Institute of Oceanology RAS, Moscow, Russia
[3]Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany
[4]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Introduction

The combined global land and ocean surface temperature in 2007 fell within the 10 highest on record while the average land temperature is the warmest since global records began in 1880 (Levinson & Lawrimore, 2008). Almost 40% of the Arctic sea ice cover that was present in the 1970s was lost by 2007 during the record low in summer sea-ice extent. As the climate warms the melt season lengthens and intensifies, leading to large areas of open water early during the year and less sea ice at the end of the melt season. Summertime absorption of solar energy in open water areas increases the ocean thermal energy (Serreze et al., 2009). In this context, an important characteristic of the Laptev Sea appears to be the linear-shaped flaw polynyas, which can extend from some 100 km to nearly 2000 km and reach maximal widths of up to 250 km. Flaw polynyas are zones of ice-free water or young ice that are formed between fast and drift ice due to the regional surface wind field. During wintertime the polynyas produce relatively large amounts of new ice in respect to their limited areal extent. With the steady increase in solar radiation during spring, flaw polynyas turn to areas of heat gain and strong sea-ice melt (Barreis & Goergen, 2005). This implies that large polynya openings in late winter lead to a relatively large area of open water in spring, which in turn is the reason for higher sea surface temperatures in summer.

Satellite observations of the sea ice concentration showed that in April and May 2007 large polynya openings resulted in large areas of open water in the Laptev Sea. On June 1, the western Laptev Sea was already ice-free from the coastal area up to 76°N. In the eastern Laptev Sea an open water area stretched out from the northern edge of the land-locked fast ice belt, which still covered the southeastern Laptev Sea up to 78°N. This ice-free area of more than 150,000 km^2, comprising ~30% of the total area of the LS shelf, developed in 2007 approximately 1 month earlier than in 2004-2006, 2008, and 2009. Notably these years were already record-setting years in respect to minimum summer sea ice extent in the Arctic. The observed unusual ice regime of 2007 makes this year particularly suitable to test the hypothesis that the polynya activity during late winter can significantly affect the oceanographic conditions during the ice-free summer period.

Equipment and methods

Oceanographic data and water samples were collected at 98 stations during the scientific cruise of the Russian research vessel "Ivan Petrov." Conductivity, temperature, and depth profiles (CTD) in the Laptev Sea were obtained using a pumped Sea-Bird SBE19+ system that was mounted in a cable-free carousel water sampler (SBE 32C from Sea-Bird Electronics) with 5-liter plastic water-sampling bottles. All CTD data were processed according to standard procedures as recommended by the manufacturer and averaged over 1 m. Figure 8 shows the locations of all stations where CTD casts were carried out while Table 1 shows the specifics of the used instruments. The exact positions of each station can be found in the complete sampling list in the appendix.

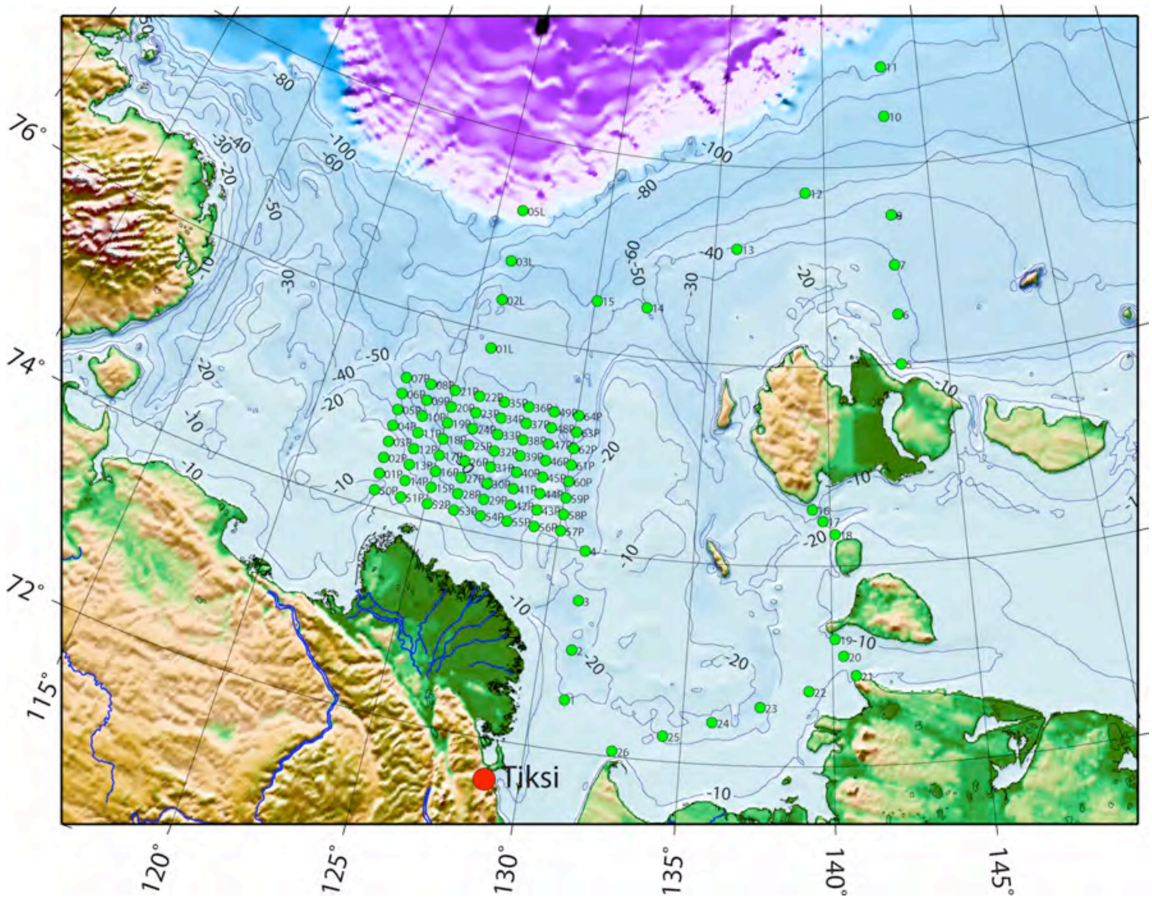


Fig. 8: Oceanographic stations that were carried out during TRANSDRIFT XII.

Investigations at oceanographic stations included water probing and sampling with the use of the following equipment: CTD probe SBE 19 plus attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module) (Fig. 9). The rosette operates offline, i.e. the operational control and data transfer are maintained without a cable.

Table 1: Details for all instruments that were mounted on the SBE19plus

Instrument	Producer	Sampling rate	Accuracy	Last calibration
Conductivity sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.0005 S/m	New instrument Factory-calibrated
Temperature sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.005°C	New instrument Factory-calibrated
Pressure sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.1% of full scale range	New instrument Factory-calibrated
Turbidity sensor	Seapoint	4 Hz	<2% deviation for 0-750 FTU	New instrument Factory-calibrated
Oxygen sensor SBE43	Seabird Electronics, USA	4 Hz	2% of saturation	New instrument Factory-calibrated

The release for automatic opening of water-sampling bottles at certain depth levels, Carousel Auto-Fire Module (AFM), includes microprocessor, semi-conductor memory, RS-232 interface, and batteries. The device records the hydrostatic pressure real-time measurements transferred by the probe and closes the sampling bottles at certain water depth levels. Also, the AFM records the sequence of bottle closures in its own memory: number, time, closure verification, and 5 CTD scans for every closed water-sampling bottle.

AFM power supply is maintained by 9 batteries Duracell MN1300 (LR20) allowing for about 40 hours of work or by nickel-cadmium batteries.

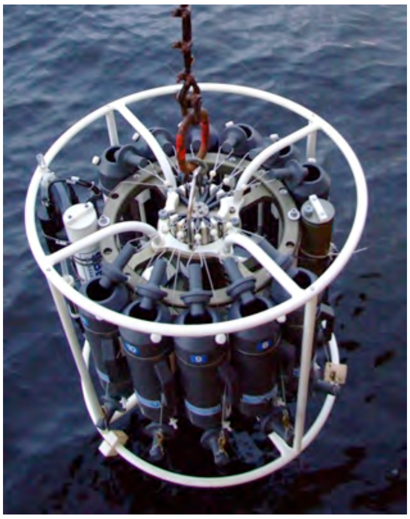


Fig. 9: CTD probe SBE 19+ attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module).

The oceanographic probe SBE 19plus SEACAT Profiler produced by Sea-Bird Electronics, Inc., USA, measures the following characteristics of seawater: temperature, conductivity, and hydrostatic pressure (Fig. 10). The measurement ranges are -5 to 35 °C for temperature, 0 to 9 cm/m for conductivity, and 0 to 600 m for hydrostatic pressure (maximum operational depth). The accuracy is 0.005°C for temperature, 0.0005 cm/m for conductivity, and 0.1% of the total measurement range for the hydrostatic pressure. Stability (monthly) of the temperature sensor is 0.0002 °C, that of the conductivity sensor is 0.0003 cm/m, and of the hydrostatic pressure sensor 0.004 % of the total measurement range. Resolution for temperature measurements is 0.0001 °C, for conductivity measurements 0.00001 cm/m for freshwater, 0.00005 cm/m for seawater, and 0.00007 cm/m for highly saline water, and for hydrostatic pressure measurements 0.002 % of the total measurement range. The frequency of along-transect measurements is 4 scans per second (4 Hz).

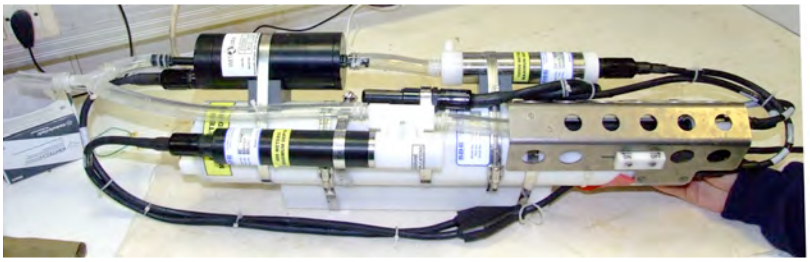


Fig. 10: Oceanographic probe SBE 19plus SEACAT Profiler equipped with sensors for measuring water turbidity, dissolved oxygen concentration and fluorescence.

The probe is equipped with a fixed memory of 8 Mb recording the measurement results. The interface is RS-232C. Power supply is maintained either by 9 batteries Duracell MN1300 (LR20) allowing for 60 hours of profiling or nickel-metalhydride or nickel-cadmium batteries. Information is downloaded from the fixed memory after the end of measurements with the help of standard cable and software. Remote data downloading is not possible for this probe.

The probe is equipped with additional sensors produced by Sea-Bird Electronics, Inc., USA, for measuring water turbidity, dissolved oxygen concentration and fluorescence.

First results

The hydrographic observations during September 2007 showed surface water temperatures north of the Lena Delta that were 3 to 5°C higher than the climatic mean for August and September based on the 1920-2008 AARI data set (Fig. 11). This was accompanied by a surface water salinity anomaly with salinities up to 10 Practical Salinity Units (PSU) higher than the long-term mean for August and September (Fig. 12).

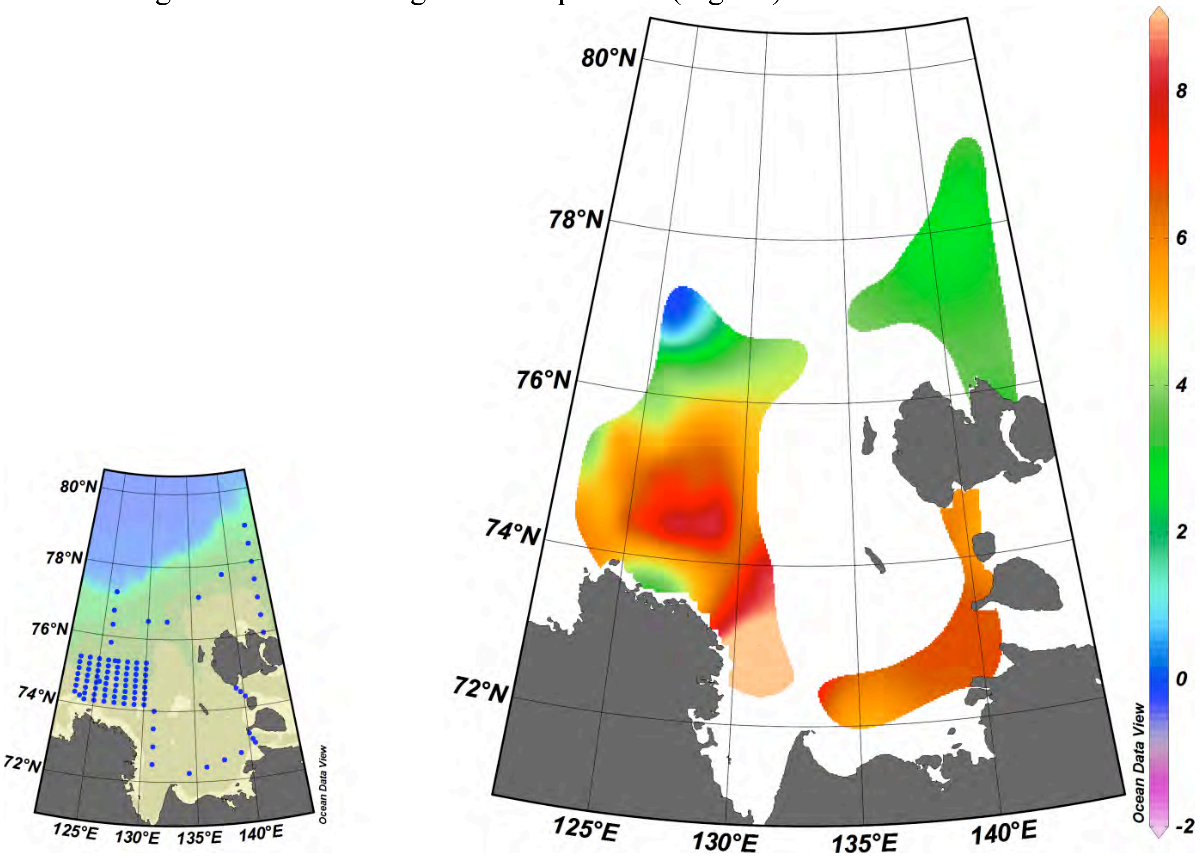


Fig. 11: Water temperature (°C) in the surface layer (3 m water depth) during the TRANSDRIFT XII expedition in September 2007.

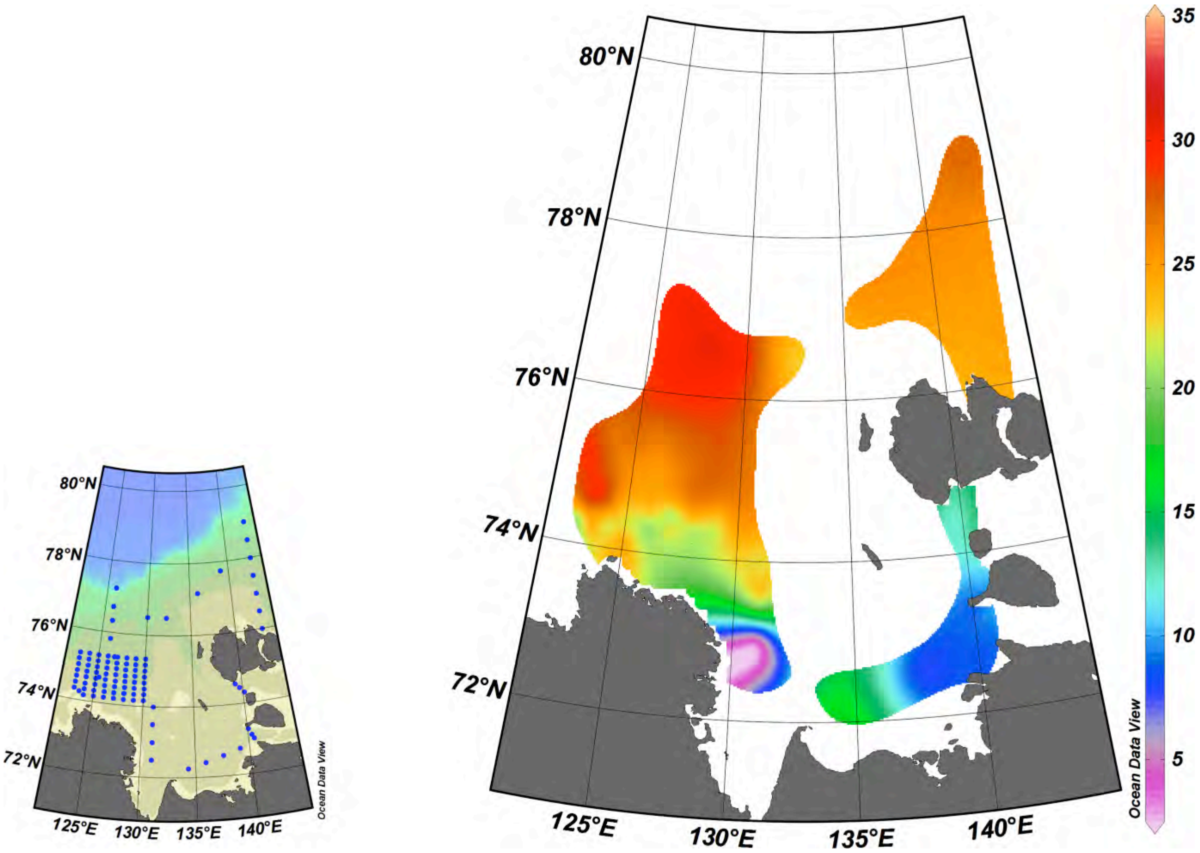


Fig. 12: Salinity (PSU) in the surface layer (3m water depth) during the TRANSDRIFT XII expedition in September 2007.

The water column in the Laptev Sea is stratified with an approximately 10 m thick fresh surface layer separated from the saltier and usually colder water below by a pycnocline situated between 10 m and 20 m water depth (Fig. 13). At the mooring position of KHATANGA the maximum difference between the long-term mean temperature for August and September and the observed temperature in the surface layer in 2007 was 5.5°C at 10 m water depth.

Most likely the high surface temperatures in 2007 are due to a combined effect of direct insolation (Perovich et al., 2008) and large areas of open water that developed in the Laptev Sea already very early during the year. The relatively high salinities in the western and northeastern Laptev Sea were obviously a consequence of the prevailing westerly wind that forced the freshwater plume of the River Lena to the east and salty surface waters from the northwestern Laptev Sea towards the area north of the Lena Delta. These conclusions are in agreement with the earlier findings by Shpaiker et al. (1972) and Dmitrenko et al. (2005, 2008a) that show the strong influence of atmospheric forcing on the distribution of river discharge on the Siberian shelf. At the position of the mooring KHATANGA the early ice retreat and the westerly winds resulted in a ~10 m thick surface layer with temperatures that were up to 5°C higher and a salinity difference between surface and bottom waters that was ~5 PSU lower than the long-term mean. These observations support the hypothesis that the ice regime in the Laptev Sea during late winter and spring also affects the temperature and salinity distribution during summer.

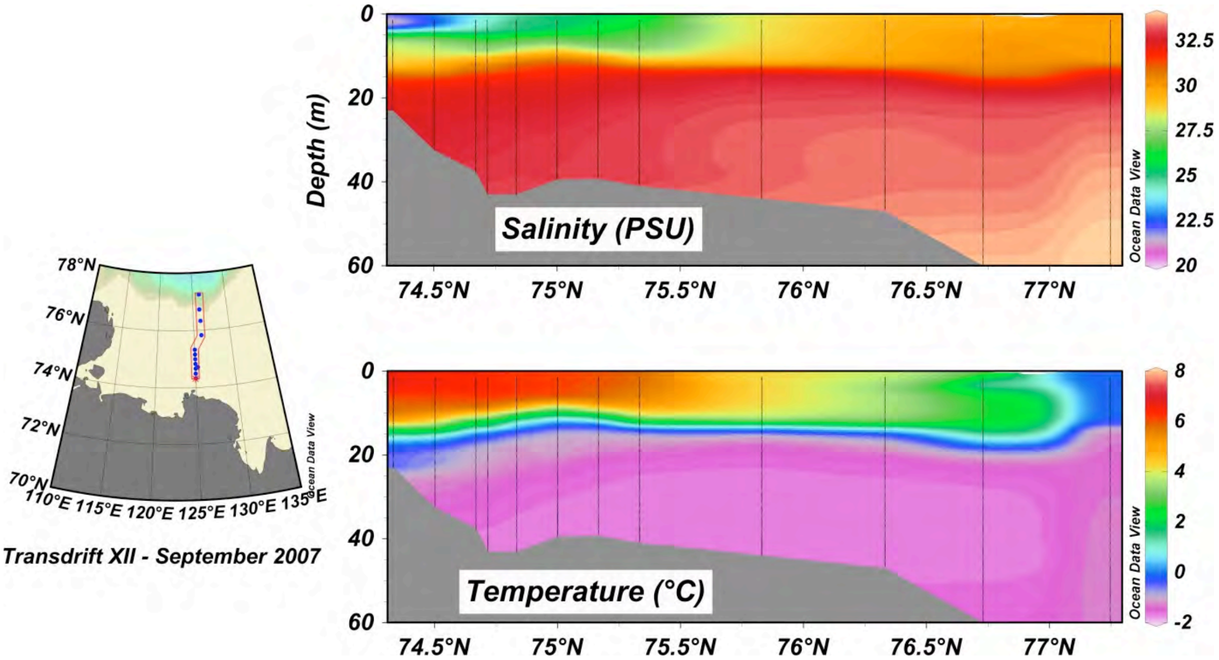


Fig. 13: Temperature and salinity distribution along a NS profile from the Lena Delta to the continental slope of the Laptev Sea (TRANSDRIFT XII). The profile is crossing the position of the seafloor observatory KHATANGA.

Seafloor observatories

T. Klagge
Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

During the TRANDRIFT XII expedition two seafloor observatories (ANABAR and KHATANGA) were deployed for the period of one year (Fig. 14). The aim was to study the seasonal variability in temperature and salinity distribution, the current regime and the transport on the mid-shelf of the Laptev Sea as well as to monitor the sea ice conditions. The seafloor observatories were deployed north of the Lena Delta to obtain information about the dynamic processes in the ocean during polynya openings. Two seafloor observatories, namely OSL2 and OSL2B, were successfully recovered during the TRANSDRIFT XII expedition. The seafloor observatories were deployed in 2005 and 2006 during the international NABOS expedition on board the Russian ice-breaker "Kapitan Dranitsyn" to study shelf-basin interactions near the continental slope of the Laptev Sea.

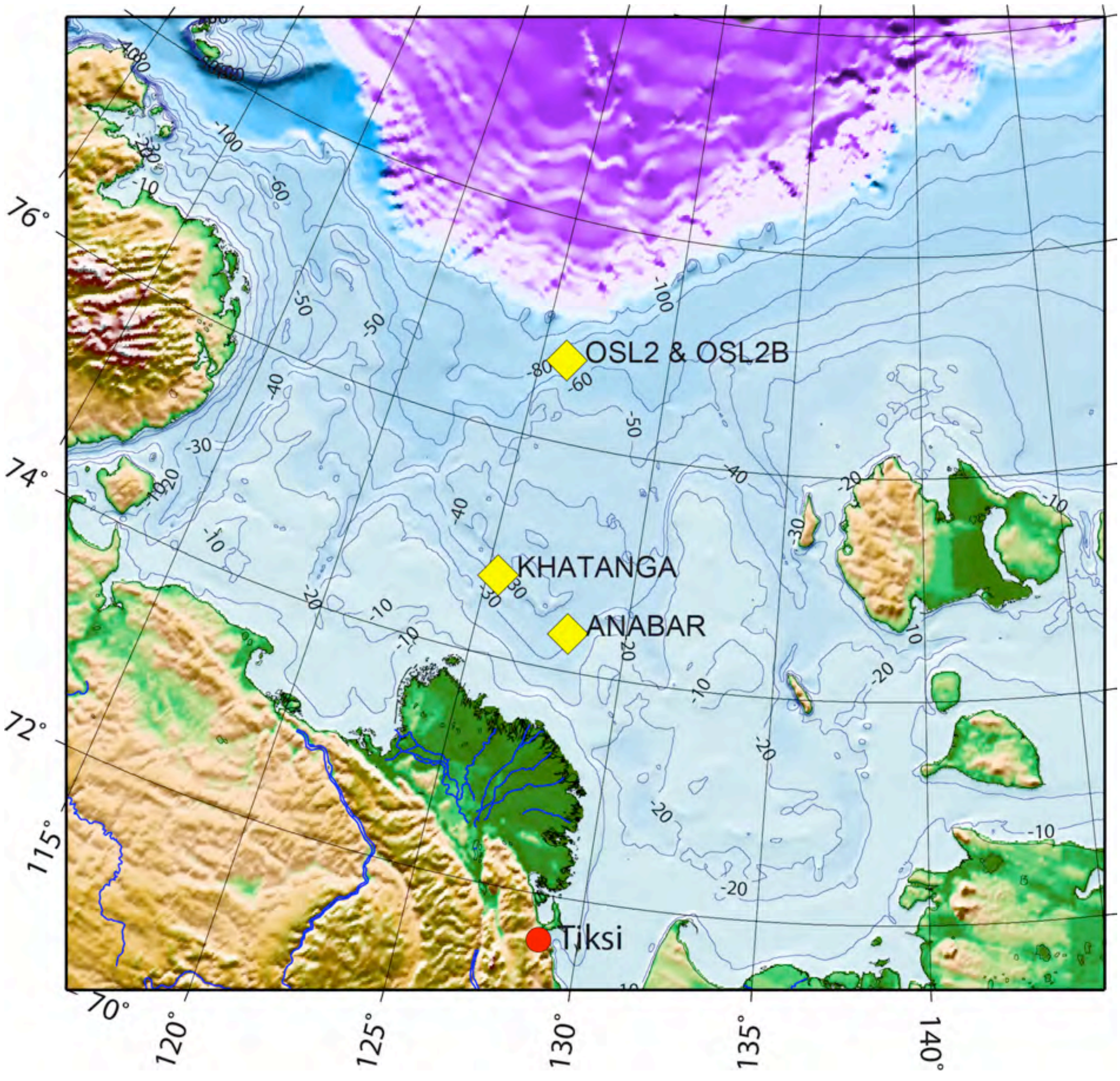


Fig. 14: Position of the seafloor observatories ANABAR and KHATANGA, deployed for the period of summer 2007 to summer 2008.

ANABAR (Fig. 15)

Deployed: 2007-09-02, 05:46 UTC
Position GPS60: 74° 19.934'N, 128° 00.027'E; Decimal: N74.33223°, E128.00045°
Position Ship: 74° 19.980'N, 128° 00.129'E
Depth: 32 m
Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9226
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I;
  Memory: 64 Mbyte Flash-memory
  Serial: 9208
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14606
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14605
- Release IXSEA OCEANO 2500
  Serial: 002
- Release IXSEA OCEANO 2500
  Serial: 003

Sampling:

- the ADCPs (Acoustic Doppler Current Profilers) are both programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTDs from RBR are both programmed to take a full sample (= temperature, conductivity, turbidity) every 30 minutes

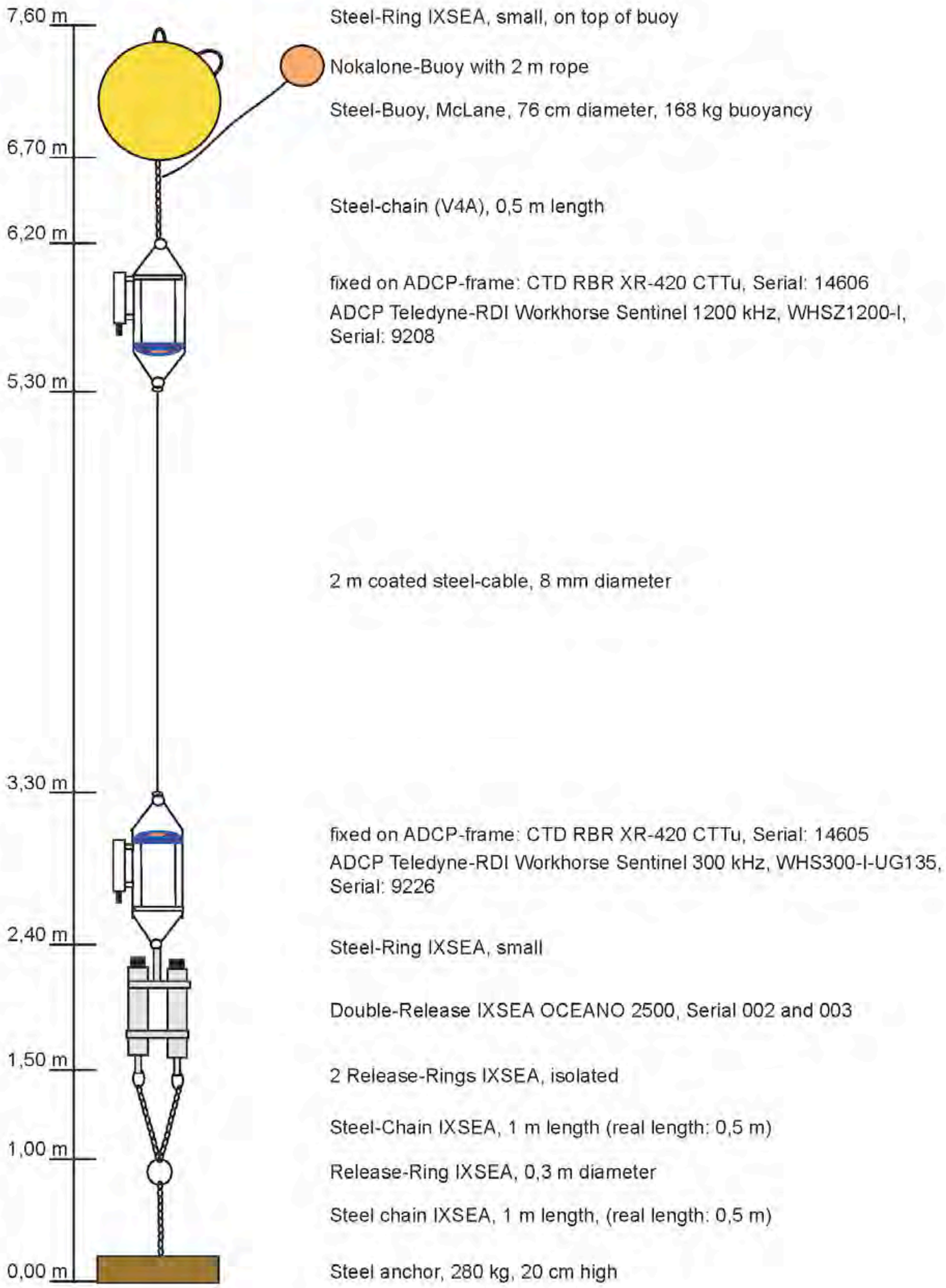


Fig. 15: Design of the seafloor observatory ANABAR, deployed on September 2, 2007.

KHATANGA (Fig. 16)

Deployed: 2007-09-03, 12:26 UTC
Position GPS60: 74° 42.934'N, 125° 17.380'E; Decimal: N74,71557°, E125,28966°
Position Russen-PC: 74° 42.928'N, 125° 17.346'E
Depth: 43 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9271
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I;
  Memory: 64 Mbyte Flash-memory
  Serial: 9207
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14604
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14607
  Attention: without turbidity sensor!
- CTD Seabird 19 (Seacat Profiler)
  Memory: 2 Mbyte Flash-memory
  Serial: 1920430-2761
- Release IXSEA OCEANO 2500
  Serial: 004
- Release IXSEA OCEANO 2500
  Serial: 005

Sampling:

- the ADCPs are both programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE19 is programmed to take a full sample (= pressure, temperature, conductivity) every 30 minutes
- the CTDs from RBR are both programmed to take a full sample (= temperature, conductivity, turbidity) every 30 minutes

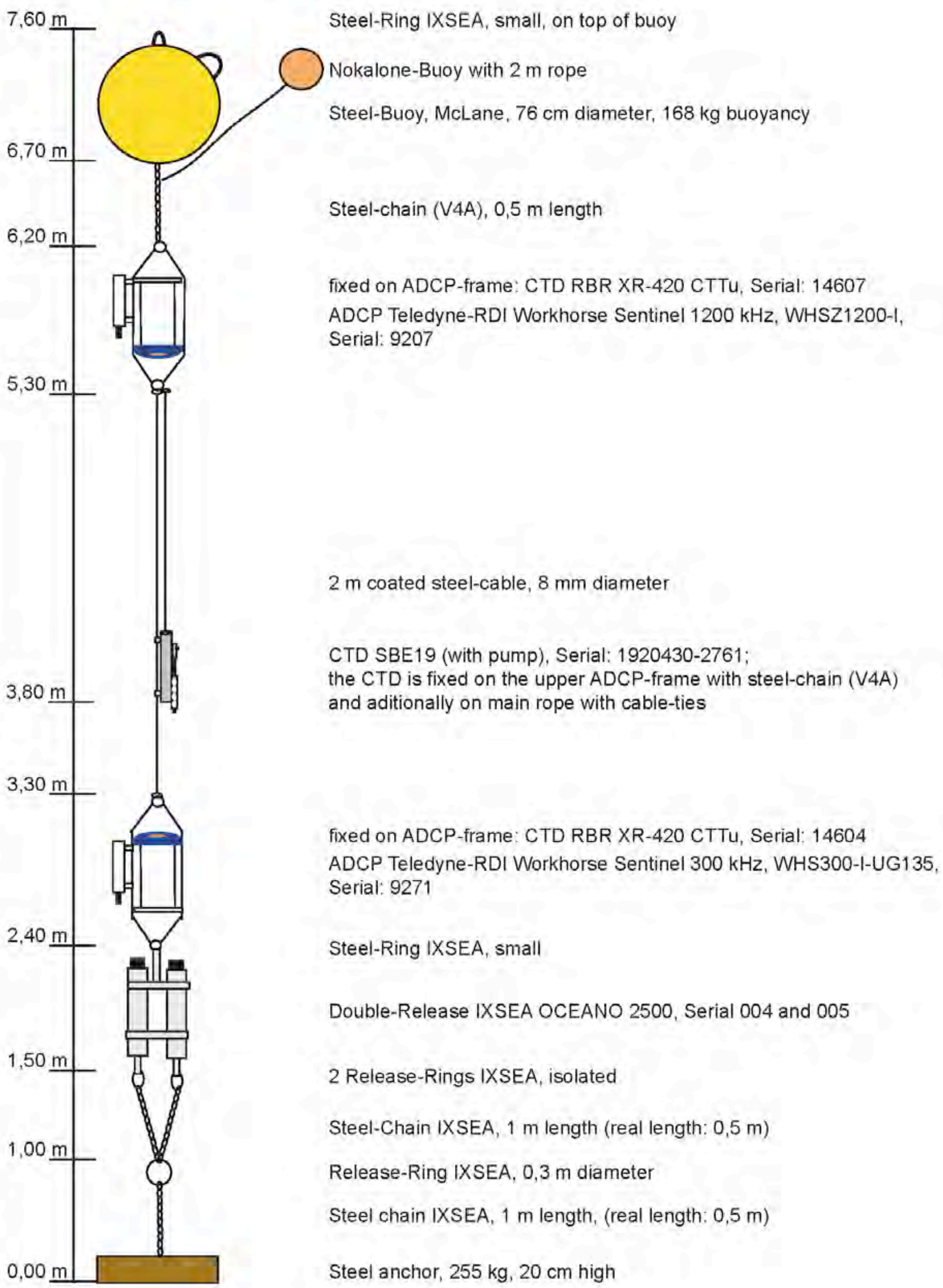


Fig. 16: Design of the seafloor observatory KHATANGA, deployed on September 3, 2007.

Hydrochemical investigations

A. Novikhin[1], J. Hoelemann[2]
[1]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[2]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

Hydrochemical investigations are important for environmental monitoring. Dissolved oxygen is essential for the respiration of organisms. It accumulates in seawater due to photosynthesis and seawater/atmosphere exchange. It is then utilized for respiration and the decomposition of organic matter. Nutrients (silicates, phosphates, nitrites, nitrates) form the mineral basis for primary production. Together with temperature and salinity hydrochemical parameters give evidence for the distribution of water masses and their temporal and spatial variability.

Material and approaches

During the expedition, water sampling for hydrochemical analyses was carried out at 195 stations (Fig. 17). The total number of samples for nutrients was more than 1500, and the concentration of dissolved oxygen was measured in more than 1300 samples. More than 200 samples for dissolved organic carbon and 45 samples for nutrients were collected from porewater of bottom sediments.

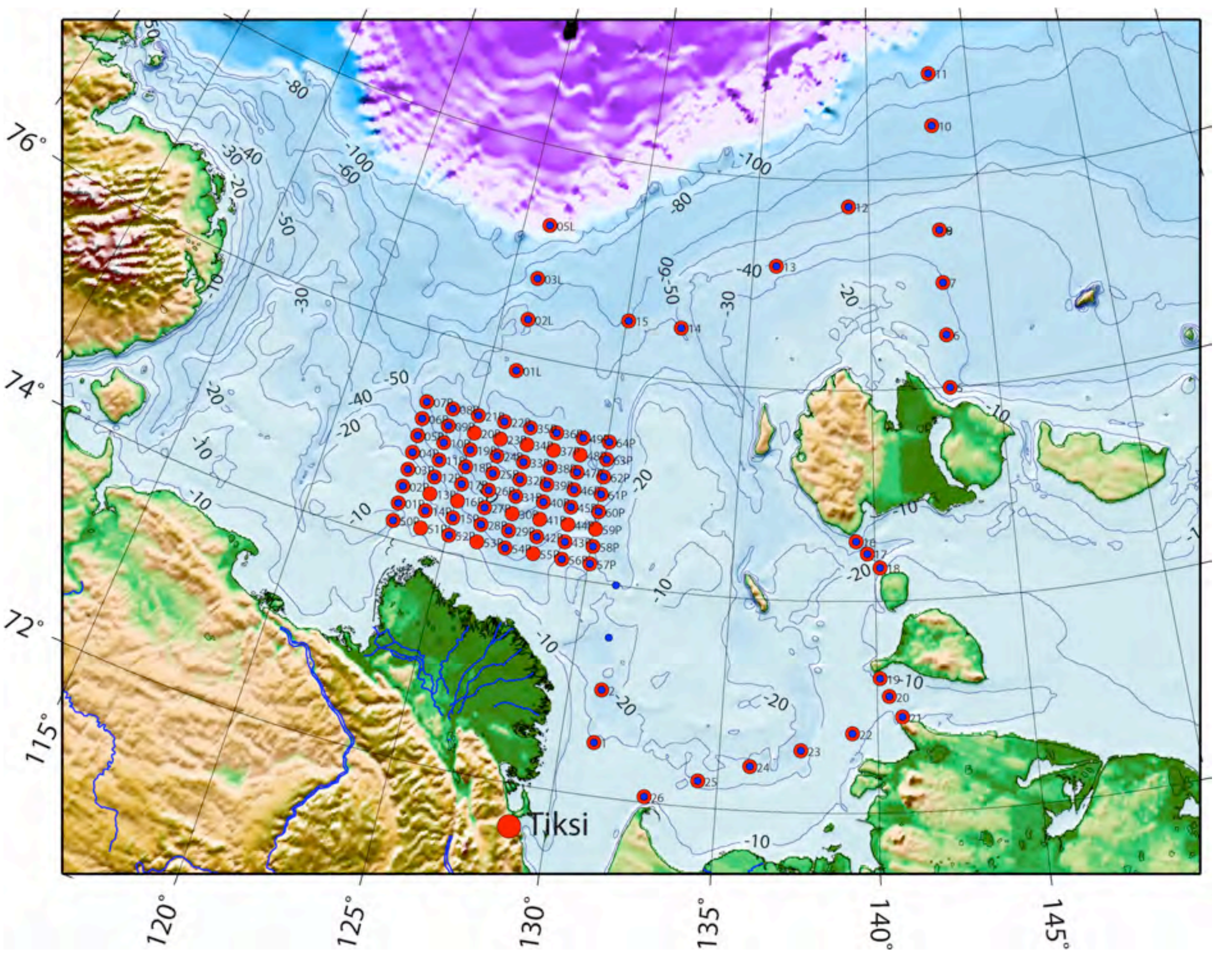


Fig. 17: Stations where water samples for oxygen and nutrients (red) and for $\delta^{18}O$ (blue) were taken.

For water sampling we used a oceanographic rosette SBE 32C Carousel Water Sampler (Compact) produced by Sea-Bird Electronics, Inc., USA, with 12 plastic 5-liter water sampling bottles (see chapter “Oceanographic investigations” by Kuz’min, Ermakova, Klagge, and Hoelemann).

The water samples are used for measuring nutrient content, chlorophyll *a* concentration, suspended matter and organic carbon content, concentration of dissolved oxygen and oxygen isotope ^{18}O. Dissolved oxygen concentration was measured onboard. The concentration of nutrients (phosphates, silicates, nitrites, nitrates), suspended matter and organic carbon content, and chlorophyll *a* are measured in the Otto Schmidt Laboratory for Polar and Marine Sciences (OSL, St. Petersburg).

Samples for oxygen concentration were taken first. Water was sampled into 100-ml glass bottles. After sampling, oxygen was fixed by sequential adding of 1 ml of manganese chloride and 1 ml of a potassium iodine and sodium hydroxide solution. The sample was mixed until an evenly distributed residuum was formed. After precipitating it was dissolved by addition of 2 ml of sulphuric acid. The dissolved oxygen content was determined by titration with sodium thiosulphate following the modified Winkler method (Oradovsky, 1993) with the use of an automatic burette ABU-80. The dissolved oxygen content was additionally measured with an SBE-43 sensor installed on the oceanographic SBE19 plus probe.

Water and sediment samples for nutrients were collected in 50, 100 and 125-ml plastic bottles. Immediately after sampling the bottles were either frozen at <-20ºC and later transported to the laboratory for further analysis, or processed onboard with the molybdate complex colorization method using a photo colorimeter CFC-3M.

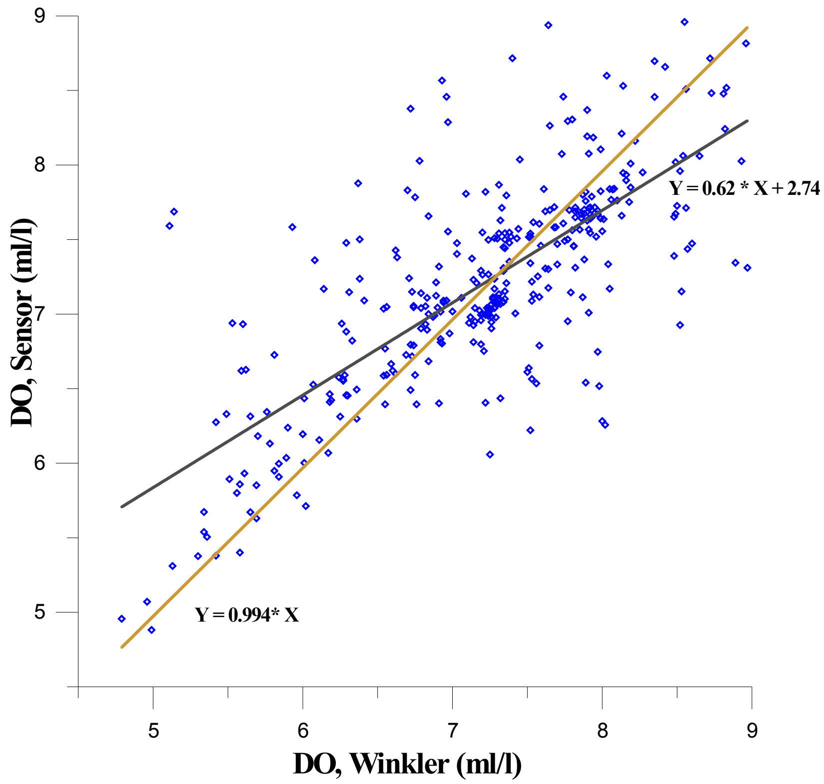


Fig. 18: Calibration of dissolved oxygen concentration values measured by the sensor.

Besides the standard Winkler method to determine the dissolved oxygen concentration we also used the sensor for dissolved oxygen concentration produced by SeaBird Company which was attached to the CTD probe. Figure 18 shows a comparison between the data obtained by the two methods, and Figure 19 shows the error of sensor measurements. A comparison demonstrates that the sensor provides a reliable picture of the dissolved oxygen distribution in the water column. The resolution of sensor-based profiles is comparable with the resolution of CTD probing. However, the sensor measurements have an acceptable error (about 5-10%) only within the range of dissolved oxygen concentration of 6.5-8.0 ml/l. Close to the endmembers the error is up to 50%, and the sensor tends to make low values higher, and to make high values lower. But this sensor is considerably more precise than the previous models.

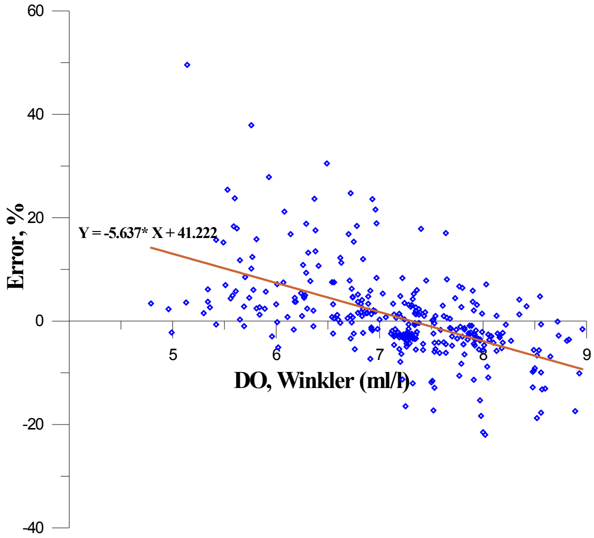


Fig. 19: Error of dissolved oxygen concentration measurements by the sensor.

In the middle of Leg 3 (after station 3_221) for unknown reasons the calibration of the sensor was disturbed. The data obtained later are considerably lower than those measured with the Winkler method. However, comparison of the obtained profiles shows that this error is permanent, therefore, it is possible to calculate the absolute values of dissolved oxygen concentration at stations 3-222 to 3-285 with the help of the titration method.

Preliminary results

To compare the expedition results with climatic data, we used the archive database for climatic measurements in September in the Laptev Sea and in August and October in the Kara Sea for the whole period of observations from 1922 until 2006.

Temperature, salinity, dissolved oxygen concentration, fluorescence, and turbidity distributions along transect 126°E are shown in Figure 20. Temperature and salinity distributions are in accordance with the observational climatic data. The upper pycnocline boundary lies at 13-17 m, which is slightly above its average position. Also, the surface water temperature, especially in the southern part of the transect, is by 3°C higher than the average archive values. Surface water salinity is slightly higher than the mean values, but in general the low-salinity surface water zone spreads farther northward than the archive data suggest.

Due to relatively high water temperature the dissolved oxygen concentration in the surface water layer is by 0.5-1.5 ml/l lower than average. The archive data show a maximum dissolved oxygen concentration of 8.0-8.5 ml/l in the surface water layer whereas the expedition results record maximum values of 8.5 ml/l at the depth of 20-25 m in the region to the north of 76°N.

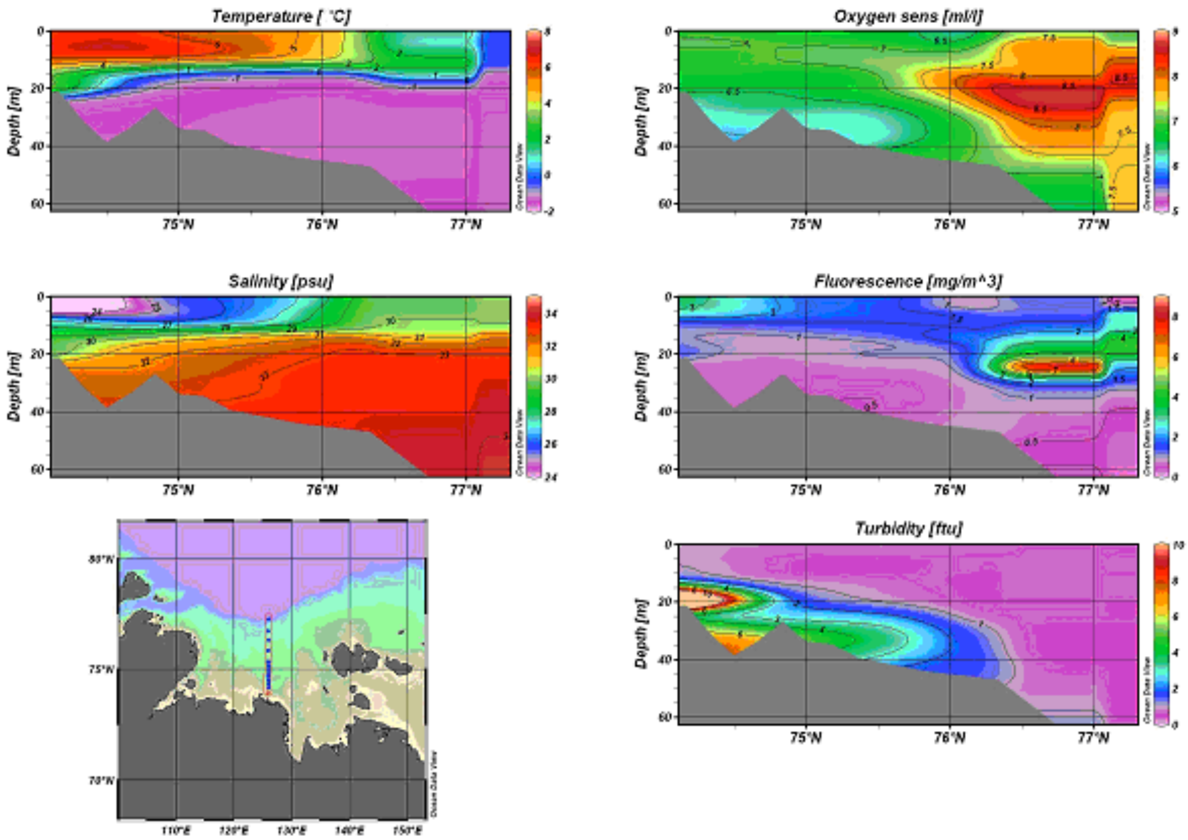


Fig. 20: Temperature, salinity, dissolved oxygen concentration, fluorescence, and turbidity distribution along transect 126°E.

Temperature, salinity, dissolved oxygen concentration, fluorescence, and turbidity distribution along transect 143°E to the north from Kotel'nyi Island is shown in Figure 21. The archive data used for the analysis of expedition results were obtained during the oceanographic surveys in 1937, 1952, 1968, and 1980.

The thickness of the surface water layer is generally in accordance with the multiannual climatic record. However, the warmer and fresher water was found to penetrate farther northward beyond 79°N, whereas the archive data show a limit of 78.5°N. Also, the temperature of the surface water layer was 1-3°C higher, and salinity was 3-4‰ lower than the average values. This is especially evident in the northern part of the transect (north of 78.7°N), where the surface water temperature is about 3°C. This zone with elevated surface temperature coincides with the zone of high fluorescence values. Dissolved oxygen concentration in this zone is similar to the surrounding area. The observed situation might be explained by active phytoplankton bloom at the sea-ice margin. The profile also displays a more evident pycnocline than is usually observed in this region.

The concentration of dissolved oxygen in the surface water layer is rather similar to the multiannual climatic record, but the maximum in the intermediate water layer is shown more distinctly. In the bottom water layer, the dissolved oxygen minimum is more evident, and its core is shifted to the south, thus extending onto the greater part of the shelf.

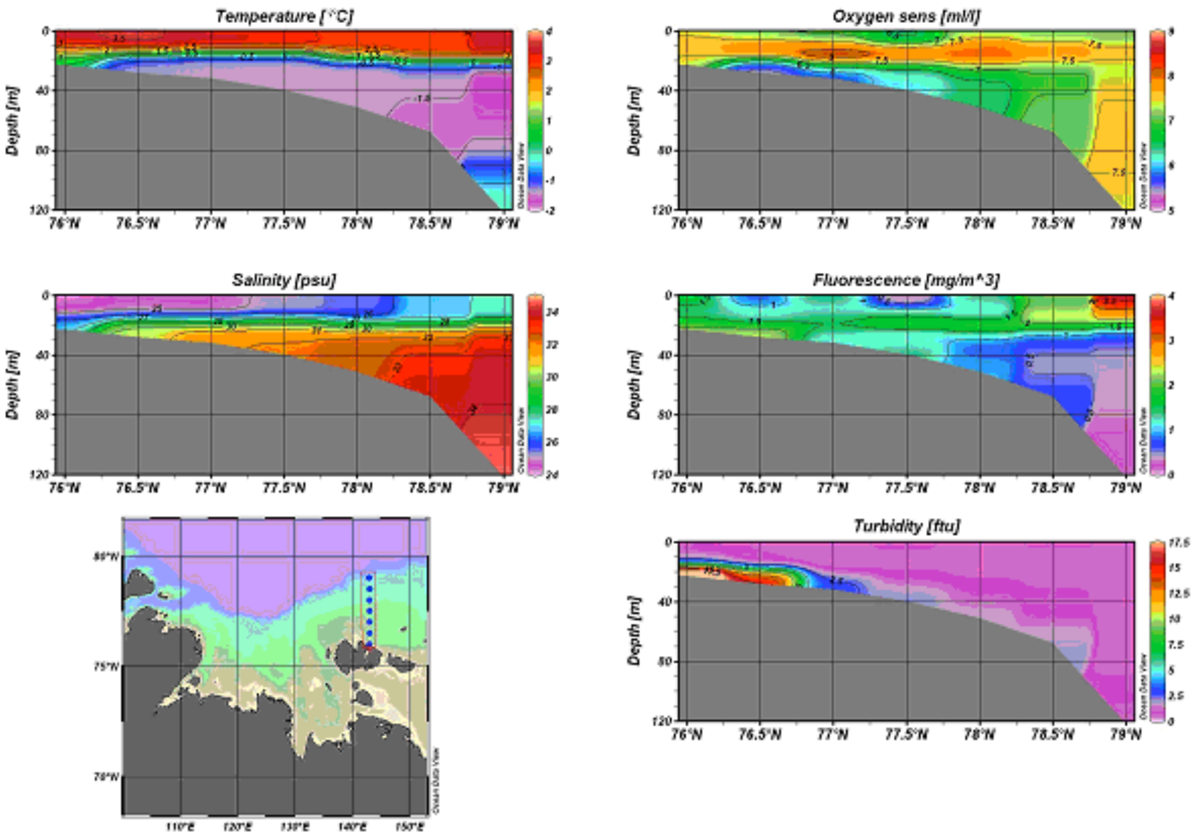


Fig. 21: Temperature, salinity, dissolved oxygen concentration, fluorescence, and turbidity distribution along transect 143°E to the north of Kotel'nyi Island.

Conclusions

The oceanographic and hydrochemical results of the expedition provide evidence for the water mass distribution in the Laptev and Kara seas during the summer and fall of 2007. In the Laptev Sea, river runoff influence stronger than average was recorded in the eastern and southeastern regions, where surface waters were warmer than usual and depleted in dissolved oxygen. River-affected surface waters penetrated farther northwestward and reached the region north off Kotel'nyi Island. Additional evidence will be provided later by analyzing the distribution of silicon. Based on the water mass characteristics displayed on the profile north off Kotel'nyi Island one can assume an enhanced inflow of bottom waters from the East Siberian Sea. Another peculiarity of this year is the well expressed maximum of dissolved oxygen in the intermediate water layer most likely resulting from its depletion in the surface water layer.

Surface sediments and downcore records: lithology and microfossils

E. Taldenkova[1], J. Gottschalk[2], J. Hoelemann[3], H. Kassens[4], Ya. Ovsepyan[1], A. Portnov[5]

[1]Geological Faculty, Moscow State University, Moscow, Russia
[2]Faculty of Geosciences, Bremen University, Bremen, Germany
[3]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
[4]Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany
[5]VNIIOkeangeologia, St. Petersburg, Russia

Introduction

The ongoing dramatic changes of the Arctic environment demand that we understand past natural variability based on the high-resolution study of shelf sediment records. Whereas the early stages of shelf inundation demonstrate replacement of paleoenvironments largely related to rapid postglacial sea-level rise, the late Holocene sediments accumulated after sea-level stabilization close to its modern position contain evidence for climate-induced changes in water circulation, freshwater runoff and sea-ice extent (Bauch et al., 1999, 2001; Bauch & Kassens, 2005; Taldenkova et al., 2005, 2008a, 2009; Polyakova et al., 2005, 2006).

Reconstructions are primarily based on biogenic and sedimentologic proxies. Modern analogues are applied to evaluate ecological preferences of fossil groups and to relate the lithological characteristics to water circulation pattern and sea-ice cover distribution. Research activities of the marine geology group are aimed at the reconstruction of past environmental changes especially during the Late Holocene on the basis of a modern analog approach. The main research tasks are:

- analysis of the spatial distribution of modern foraminifers and ostracods in surface samples from the Laptev Sea shelf in relation to water mass properties;
- analysis of the spatial variability of terrestrial ice-rafted debris (IRD) concentration and composition in surface samples of the Laptev Sea shelf in relation to sea-ice cover extent;
- high-resolution study of sedimentologic characteristics and microfossil composition of marine sediment records from different parts of the Laptev Sea, primarily, undisturbed boxcore sediment sequences.

In 2007 seafloor samples were collected in different parts of the Laptev Sea, which include both surface sediment samples and boxcore sections (Fig. 22; Tables 2, 3). Surface sediment samples were obtained at 14 stations (49 samples), and boxcore sections were collected at 10 stations. The detailed core descriptions are shown in the Appendix ("Detailed core descriptions (TRANSDRIFT XII)"). These newly obtained data will enlarge the existing database on the distribution of modern ostracods and foraminifers in the surface samples from the Laptev Sea (Stepanova et al., 2003, 2004, 2007; Taldenkova et al., 2005; Lukina, 2001) and form the necessary modern analog basis for reconstructing past changes in the fast ice cover extent and summer drift ice limit. The high-resolution study of boxcore sediment records is important for interpreting the recent changes, especially because the long cores are usually lacking the upper parts lost during coring.

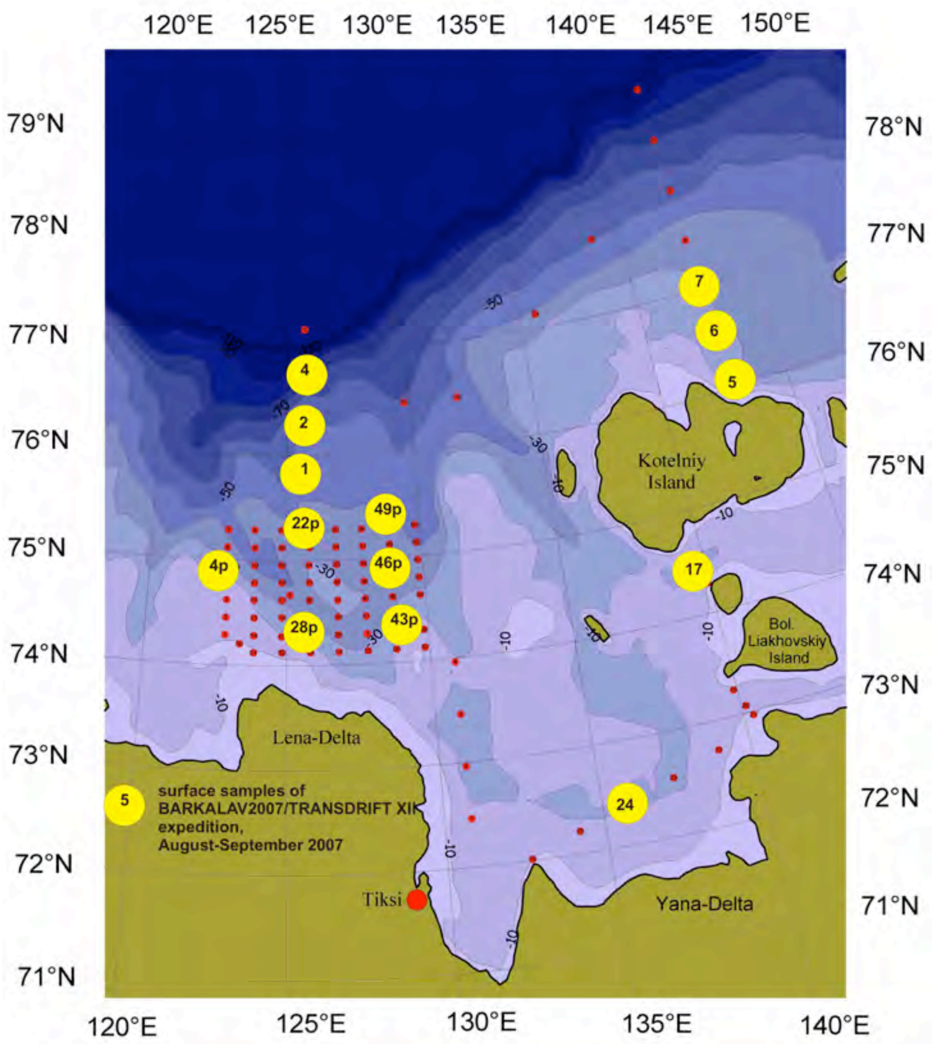


Fig. 22: Location of surface sediment sampling sites.

Table 2: The list of boxcore sections collected during TRANSDRIFT XII. Core descriptions are shown in the Appendix

Station #	Water depth, m	Sections taken per station	Section length, cm
1	44	2	20
2	47	2	26
4	62	2	26
5	18	2	23
17	28.5	1	25
24	22.5	2	24
22p	39	1	22
28p	31	1	22
46p	37.5	1	23
49p	38.5	1	28

Table 3: The list of surface sediment samples collected during TRANSDRIFT XII and the first analytical results of sedimentologic and benthic assemblage studies (bold figures and shading in column 3 mark samples from which ostracods and foraminifers have already been picked) (continued on next page)

Station #	**Water depth, m**	**Samples taken per station**	**>63µm, wt%**	**Total abundance, foraminifers /1g**	**Total abundance, ostracods/1g**	**% live foraminifers**	**% agglu-tinated fora-minifers**	**% river-proximal foraminifers**	**% *Elphidium clavatum***
43p	17	**1**	84.8	0.07	0.01	42.9	57	55.6	0
46p	37.5	**1**	2.6	2.38	0.16	49.2	70	9.39	6.1
		2	30.2	8	0.77	63.9	81	37.3	32.7
		3	7.9	4.71	1	63.1	70	34.5	47.1
		4	8.7	8.81	1.22	67.2	74	41.2	34.6
49p	38.5	**1**	40.1						
		2	29.3	12	2.3	64	54	36.5	75.7
		3	30.9						
		4	36.1						
22p	39	1	21						
		2	9.5	14.7	3.43	71.1	80	52.7	21.8
		3	7.3	6.64	2.02	62.4	76	58.6	12.5
		4	11.6						
28p	31	**1**	57.6						
		2	73.7						
		3	61.8						
		4	54.1	14.7	1.67	70.5	49	16.7	60.2
4p	28.4	1	83.7						
		2	84.6						
		3	82.2						
5	18	1	30.4						
		2	46.8						
		3	51						
		4	39.1						
6	26	1	68.9						
		2	62.2						
		3	67.3						
		4	65.9						
7	31.8	1	78.3						
		2	84.9						
4	62	1	51.2						
		2	46.4						
		3	48.3						
		4	57.8						
2	47	**1**	76.9						
		2	49.1						
		3	50.2						
		4	44.1						
1	44	1	71						
		2	66						
		3	80.4						
		4	66.2						

Table 3 (continued): The list of surface sediment samples collected during TRANSDRIFT XII and the first analytical results of sedimentologic and benthic assemblage studies (bold figures and shading in column 3 mark samples from which ostracods and foraminifers have already been picked)

Station #	**Water depth, m**	**Samples taken per station**	**>63µm, wt%**	**Total abundance, foraminifers /1g**	**Total abundance, ostracods/1g**	**% live foraminifers**	**% agglu-tinated fora-minifers**	**% river-proximal foraminifers**	**% *Elphidium clavatum***
17	28.5	1	3.9						
		2	8.2	1.33	0.18	61.3	31	11.6	16.8
		3	2.7	0.73	0.18	67.6	28	52.8	13.2
		4	9.5						
24	22.5	1	18.5						
		2	41.5						

To estimate the concentration of suspended particulate matter in the water colume 27 water samples were taken at defined water depths (surface, 5, 10, 15, 20 m, bottom water) at 27 stations (Fig. 23). The distribution and dynamics of suspended particulate matter (SPM) influence the primary production in terms of availability of nutrients and the absorption of light. Changes in the SPM concentration and distribution might have serious effects on the sensitive Arctic ecosystem, e.g., increased SPM concentration via sediment resuspension and river discharge might impede primary production by limiting light penetration.

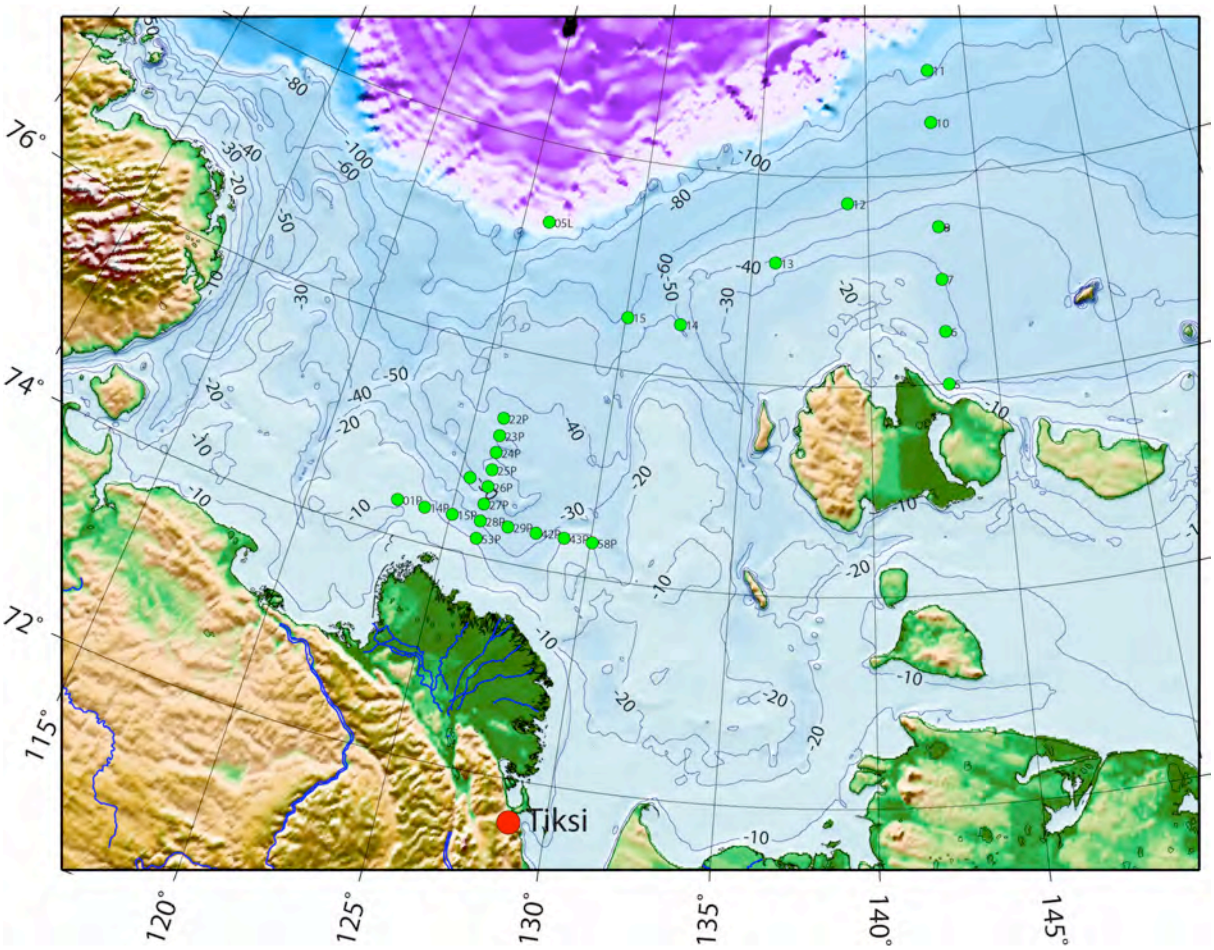


Fig. 23: Stations where SPM measurement were carried out.

Short sediment cores (up to 30-40 cm) were taken from the boxcore using plastic tubes. Surface sediment samples were taken from the boxcore as the surface 1-2 cm thick sediment layer collected over an area of 0.01 m^2. They were stained with 5% solution of Rose Bengal in order to identify the percentage of live and dead tests. Surface samples represent the upper 1-2 cm of sediment. For obtaining statistically more reliable data, 2 to 4 samples were collected from the same boxcore. Samples were dried in the oven and then washed over 63-µm meshsize sieve and dried again. The weight percentage of the coarse fraction was estimated. All tests of ostracods and foraminifers were picked from the dry residue and studied under binoculars for species identification. To collect ice-rafted debris (IRD) sediments were dry-sieved over 500 and 2,000 µm sieves, and all mineral grains were picked from the size fractions 500-2000 and >2000 µm and studied under binoculars to identify their composition. Total abundance of tests and concentration of grains were estimated per 1 g dry bulk sediment.

Preliminary results

Surface samples

All surface sediment samples from the summer 2007 expedition were processed. Foraminifers and ostracods were picked from 21 samples, and species composition was identified in 11 samples (Table 3). The remaining samples are currently being analyzed for foraminifers and ostracods. All surface samples from the recent expeditions together with surface samples from previous expeditions are being analyzed for mineral grains.

The first results indicate an evident patchiness in distribution of sedimentologic characteristics (coarse fraction percentage) and meiofauna within surface samples from the same boxcore (Table 3, see station 46p, samples 1-4). Total abundances of foraminifers and ostracods increase with depth. Foraminiferal assemblages are dominated by agglutinated forms.

Foraminifers, collected alive, constitute the major part of tests independently of sediment lithology, which might be indicative of rather active post-mortem dissolution rather than the influence of bottom hydrodynamics. The opportunistic species *Elphidium clavatum* and river-proximal species (*Haynesina orbiculare, Elphidium incertum, E. bartletti, Elphidiella gorenlandica, Buccella frigida*) are the most abundant among calcareous foraminifers in the studied samples. This is in accordance with the previous investigations of the distribution of foraminifers in river-affected Arctic shelf seas (Tamanova, 1971; Khusid, 1996; Polyak et al., 2002).

Downcore records and paleoreconstructions

Previously, we investigated the composition of microfossils from radiocarbon-dated boxcore and kasten core sections which were shown to reflect the Late Holocene variability in the strength of open-sea and freshwater influence (Taldenkova et al., 2008a, 2009). We will continue these investigations through the analysis of microfossils in the newly obtained boxcore sections.

IRD content is another important proxy for reconstructing past positions of frontal zones in the marginal Arctic seas, i.e., the fast ice edge and the summer drift ice limit, as well as iceberg-rafting events in the deeper areas. Last year the main focus of our research activities was high-resolution analysis of IRD from boxcore and kasten core sections recovered in the western Laptev Sea outer shelf and upper continental slope (Taldenkova et al., 2008b; Gottschalk, 2008). It was shown that prominent IRD spikes are attributed to iceberg-rafting, especially for the deeper site on the continental slope, and also to transgressive depth-related changes in the character of the sea-ice cover from fast to drift ice for the outer shelf site. On the shelf, a fast sea-ice cover existed during the early stages of inundation at 12-9.5 cal.ka. The shift to mid-shelf conditions with a polynya during winter occurred simultaneously with the establishment of climate-optimum conditions, which could be inferred from low IRD records in both cores for the time period of 9.5-7.5 cal.ka. Since ~7-7.5 cal.ka, when the sea level almost reached its modern position, IRD concentrations increase in both cores and give evidence for climate cooling. Enhanced inflow of Atlantic-derived waters at 3-5 cal.ka resulted in re-growth of ice caps on Severnaya Zemlya and the highest IRD spike at 3-4 cal.ka. An increase in the abundance of big dropstones points to iceberg-rafting. The shelf record with higher temporal resolution shows a cyclicity in IRD input (i.e., shifts in the southern summer drift ice margin and also variability of iceberg-rafting) with a period close to 1,500 years probably linked to general changes in atmospheric circulation. The planned high-resolution investigations of boxcore records from various parts of the Laptev Sea will give further evidence for the observed variability in sea-ice extent, water circulation and freshwater discharge, which are all related to climate changes.

Long sediment coring

P. Rekant[1], V. Bogin[1], V. Bol'shchikov[1], J. Gottschalk[2], P. Komar'[1], A. Portnov[1], E. Slagoda[1], V. Zakharov[1]

[1]VNIIOkeangeologia, St. Petersburg, Russia
[2]Faculty of Geosciences, Bremen University, Bremen, Germany

Introduction

During the cruise the duration of geological sampling was shortened from five to three days. The stations for long sediment coring were selected on the basis of the results of seismo-acoustic profiling carried out in the study region in 2004 (Fig. 24).

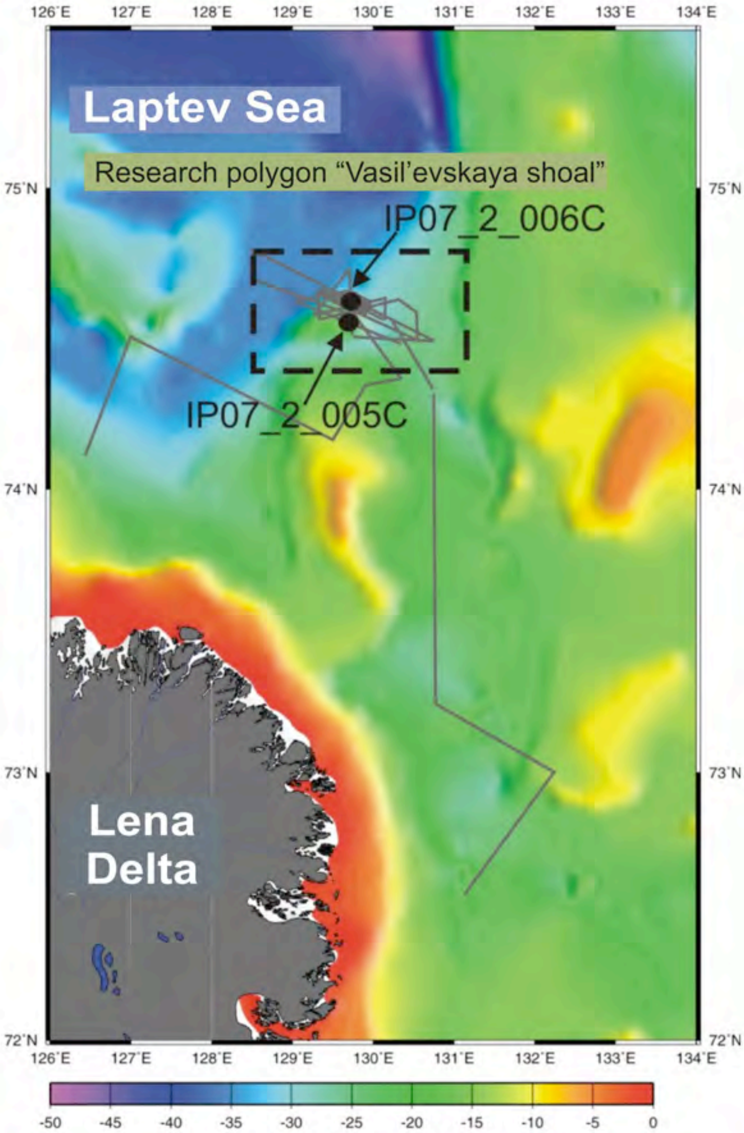


Fig. 24: Location of the long sediment coring sites. The grey line marks the seismic profile recorded during the expedition TRANSDRIFT X (2004).

During the three working days (September 13-15) long sediment core sampling was carried out at the positions IP07_2_005C and IP07_2_006C. Core lengths were 12.8 and 10 m, respectively. The first sediment core was obtained in 5 coring cycles. The second one took only 3 coring cycles. When sampling core IP07_2_006C, the weather conditions were periodically getting bad, and we had to skip sampling the intervals 190-300 cm and 580-710 cm. Core description was made onboard.

In 2007, a Multioperational Vibrocoring Device (MVD) assembled in Donetsk State University (Fig. 25) was used for recovering sediment cores up to 10-12 m long. This device was modified so that it could be use on the relatively small deck of RV "Ivan Petrov." A specific bottom frame was constructed, and also the outer tubes and core barrels were shortened. As a result, a shortened 4.5 m long borehole tool with a 2.8 m long sampling part was constructed.

Fig. 25: Multioperational Vibrocoring Device (MVD).

The operational procedure is the following. The MVD is taken outboard with the help of cargo crane and winch (Fig. 26). Then the vibrocoring starts and the first sediment section (0-2.6 m) is obtained. After that the whole device is hauled onboard and the sediment core is extracted. The second cycle of coring starts with washing away the first sediment interval (0-2.6 m). Then the underlying sediment section (2.6-5.2. m) is obtained. The cycles are repeated 3-5 times, and at the end it is possible to obtain a sediment core section up to 12 m long.

Description of sediment sequences

Core IP07_2_005C is located at the site with coordinates 74° 33.245 N; 130° 19.426 E. The first coring cycle was carried out on September 13 for testing the system. After the lower distribution unit had been adjusted, the coring started, and the first sediment section 0-2.6 m was sampled. The core section was completely filled with sediment, but when the sediment was washed out from the core barrel with the help of the slush pump (common procedure for this type of equipment), it fell onto the deck. The sediment core was then put back on a tray in accordance with the orientation and succession of fragments. This sediment section was not sampled and used for sediment description only. It was decided not to repeat the coring procedure for this interval.

Fig. 26: The MVD is taken outboard with the help of cargo crane and winch.

The second coring cycle started with washing away of the interval 0-2.8 m and further sampling of the sediment interval 2.8-5.4 m. During washing out of the sediment about 60 cm were lost because of compression. The remaining about 2.2 m long sediment section was intact (Fig. 27). This sediment interval is represented by dark gray to black silty clay.

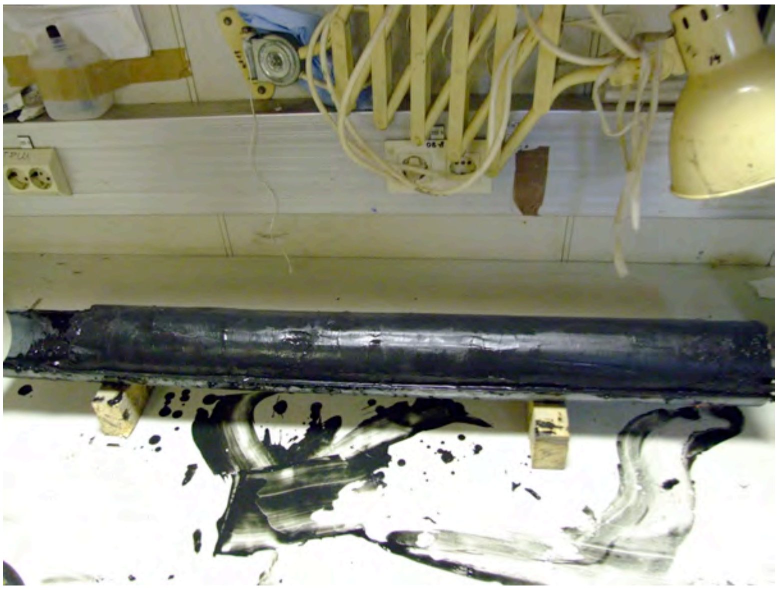


Fig. 27: Sediment section, core IP07_2_005C.

After a destroyed spring of the lower distribution unit had been replaced and tested, the third coring cycle started with washing away the sediment interval 0-5.6 m and further sediment sampling of the interval 5.6-8 m. The sediment core section was complete. However, this sediment section is represented by fine-grained sand and silt. Therefore, more than 50% of it was lost during the washing out procedure. Finally, several intact sandy sediment fragments were collected with a total length of about 1 m. This sediment section was sampled for monoliths, microfauna and lithology.

Later the long sediment coring was stopped because of the weather conditions. Sea waves were up to 3.5 m high.

On September 14, the fourth coring cycle started. Coordinates remained the same. The interval 0-8 m was washed away, and the underlying 8.0-10.8 m interval was sampled, but the sediment was completely washed away. In the core catcher (base) and separator (top) some fine sand was left. Most likely, the whole interval is represented by sand.

The fifth coring cycle started with washing away of the interval 0-10 m. The sediment was sampled in the interval 10-12.6 m. The whole interval is represented by fine sand, and no intact sediment core section was recovered. The sediment was described and sampled for lithology and microfauna.

Core IP07_2_006C was recovered at the site with coordinates 74° 36.599 N, 129° 54.757 E on September 14-15. The upper sediment interval was retrieved with a piston core. Core length was 1.9 m with 95% of intact sediment. The sediment was described, sampled and stored. Aftera a certain adjustment the second coring cycle started with washing away of the 0-2.0 m sediment interval. The core section was completely full with sediment. However, because of high waves the sampling interval was not the proper one, and in fact the sediment was obtained from the core depth of 3.0-5.6 m. The outcome of intact sediment was 80-90%. Sediment deformation of 10-20% corresponded to the parts of the core enriched either with water or polychaete tubes. The coring operation was then stopped because of the weather conditions, as the sea-waves reached 5 points.

On September 15, the ship moved to the position 74° 36.599 N, 129° 54.757 E because both bow anchors were displaced, and the ship shifted by more than 50 m during the night. After the weather conditions had improved, the third coring cycle started with washing away of the interval 0-6 m. However, because of still relatively high waves the connecting hose was broken. The coring device was lifted to a safe depth, the hose was replaced, and the sediment core from the interval 7.0-9.5 m was washed out. The length of the intact sediment was 220 cm (Fig. 28). 30 cm of the sediment were destroyed.

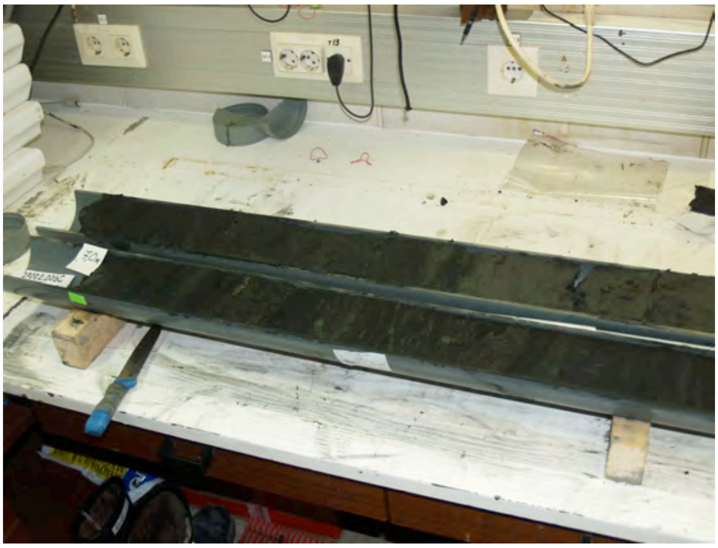


Fig. 28: Core IP07_2_006C, sediment section 7.0-9.5 m.

Further deterioration of weather conditions and destruction of core catcher lobes made further coring impossible.

The cores IP07_2_005C and IP07_2_006C were described onboard, the results are given in Tables 4 and 5, respectively.

Table 4: Sediment description, core IP07_2_005C (continued on next page)

Date of coring - 13.09.07-14.09.07 **Water depth – 30 m** **Coordinates - 74^{O} 33.245 N; 130^{O} 19.426 E** **Total coring depth interval - 0-12.8 m**			
Core depth interval [cm]	**Coring cycle**	**Sediment thickness [cm]**	**Sediment description**
0-100	1	100	Silty clay, greenish gray, with black spots of hydrotroilite, debris of gastropod shells, soft-plastic, water-saturated, laminated. Lamination due to intercalation of layers with different texture: intervals 0-10, 27-43, 46-70, 90-100 cm represented by spots and lenses against gray and greenish gray background sediment with worm-like tubes filled with hydrotroilite intercalate with 17-20 cm layers of black, dark gray and greenish-gray color with unclear lamination
100-200	1	100	Silty clay, laminated, water-saturated, soft-plastic. Sediment intervals 100-160, 170-190, 194-200 cm are represented by finely laminated greenish gray, dark gray and black subhorizontal 1-mm thick interlayers with black layers up to 2-2.5 cm thick. Sediment intervals 160-170 and 190-194 cm are represented by greenish gray sediments with dendritic polychaete burrows filled with black hyrotroilite. At the depth of 175-177 cm an interlayer of light greenish gray silty clay with roiling texture
200-460	2	260	Silty clay, dark gray, sometimes greenish, with black sooty spots, shell debris, laminated. Sediment intervals 205-220, 300-370, 410-440 cm have dendritic texture formed by worm or polychaete tubes filled with greenish gray sediment, interlayers of homogeneous dark gray silty clay, and single big (up to 2 cm) spots of light greenish gray silty clay. The latter are surrounded by black particles. Silt content increases at the depth of 450-460 cm. The sediment section is viscous-plastic, monolithic
500-770	3	270	480-510 cm: silty clay, gray and dark gray, with fine sand, mica, and black sooty spots (>1 mm); 510-530 cm: sandy silt, greenish gray, with black sooty spots, dense, viscous, water-saturated; 530-600 cm: fine silty sand, dark gray, with mica and black sooty spots, dense water-saturated with lump structure; 600-700 cm: fine sand, yellowish-greenish gray, with mica, interlayers of muddy and clean sand in the interval 600-630 cm, fragments and valves of *Cyrtodaria kurriana* (identification made by A. Gukov, depth habitat 0-9 m on the nearshore area); 700-750 cm: fine sand with bivalves with biggest valves reaching up to 2 cm in length found at the base of the layer (sampled for radiocarbon dating), basal sediments are also enriched in plant debris. The sediment interval displays a pocket of dark gray clayey sand (5x2 cm) with wavy side boundaries represented by fine interlayers of black and yellowish gray sand and up to 2-6 cm thick lower boundary represented by dark gray clayey sand with black sooty spots. The pocket penetrates into the fine sand with bivalves (no washing out of core sediments occurred, and the overlying sands do not show any signs of erosion); 750-780 cm: fine sand, yellowish gray, water-saturated, thixotropic (quicksand)
800-1000	4	200	Fine sand, yellowish dark gray, water-saturated, thixotropic (quicksand)
1000-1280	5	280	Fine sand, greenish- and dark gray; from the depth of 1200 cm: fine silty sand with a sandstone fragment, water-saturated, thixotropic (quicksand)

Table 5: Sediment description, core IP07_2_006C (continued on next page)

Date of coring - 14.09.07-15.09.07 **Water depth – 29.5 m** **Coordinates - 74^{O} 36.599 N; 129^{O} 54.757 E** **Total coring depth interval - 0-10.0 m**			
Core depth interval [cm]	**Coring cycle**	**Sediment thickness [cm]**	**Sediment description**
0-190 Piston core	1	190	0-3 cm: silty clay, gray, with horizontal 2-3-mm thick lenses filled with greenish gray silty clay and with spots of ochreous iron hydroxides filling polychaete burrows, water-saturated, soft-plastic; 3-6 cm: silty clay, greenish dark gray, homogeneous, with a big (3 cm) greenish light gray spot; 6-10 cm: silty clay, laminated, intercalation of black, dark gray, and light greenish gray 1-10 mm thick lenses, subhorizontal and inclined; 10-16 cm: silty clay, laminated, intercalation of black and dark gray 10-15 mm thick lenses; 16-23 cm: silty clay, laminated, intercalation of black, dark gray, and light greenish gray 1-2 mm thick subhorizontal lenses, soft-plastic; 23-32 cm: silty clay, dark gray, with greenish gray subhorizontal inclusions along worm (?) burrows; 32-37 (38) cm: silty clay, dark gray, with greenish gray dendritic inclusions along worm (?) burrows; the lower boundary inclined and sharp; dense, viscous-plastic; 37-65 cm: silty clay, laminated, 1-10 mm thick layers of black, dark gray, and greenish gray colour; with rare rounded inclusions of the silty clay with worm burrows; lamination destroyed by the inclusion; 65-88 (100) cm: silty clay with inclined lamination formed by up to 20 mm thick black and gray interlayers; wavy lower boundary, bivalve fragments, soft-plastic; 88 (100)-107 (109) cm: silty clay with inclined lamination formed by compressed greenish gray worm burrows; upper boundary with small pockets (submarine slide), worm tubes are more compressed at the upper boundary than below; lower boundary is slightly inclined; sediment is dense and viscous-plastic; 107-119 cm: silty clay, greenish gray, homogenous, with black spots, less dense than the overlying layer; plastic; 119-125 cm: silty clay, black, with narrow flexuous subhorizontal lenses of greenish gray silty clay infilling worm burrows; dense, viscous; 125-136 cm: silty clay, greenish gray, homogenous, with small 1-2 mm in diameter black spots with dark gray outline; 136-150 cm: silty clay, laminated, dark gray subhorizontal and slightly inclined layers intercalate with greenish gray and black lenses 1-10 mm thick; 150-174 cm: silty clay, finely laminated, intercalation of black, gray, greenish gray lenses and thin layers, rare greenish gray worm burrows, one big inclusion of silty clay with worm-like texture; 174-190 cm: silty clay, laminated, predominantly dark gray subhorizontal and slightly inclined layers; temperature of the sediment at the depth of 190 cm -1.5°C.

Table 5 (continued): Sediment description, core IP07_2_006C (continued on next page)

Date of coring - 14.09.07-15.09.07 **Water depth – 29.5 m** **Coordinates - 74^{O} 36.599 N; 129^{O} 54.757 E** **Total coring depth interval - 0-10.0 m**			
Core depth interval [cm]	**Coring cycle**	**Sediment thickness [cm]**	**Sediment description**
300-580	2	280	300-318 cm: clays and silty clays with obscure lamination formed by dark gray and greenish gray layers, soft-plastic; 318-335 cm: silty clay, dark gray, with dendrithic inclusions of greenish gray sediment infilling worm burrows; viscous-plastic; 335-380 cm: silty clay, finely laminated, lamination formed by inter-calation of irregular 1-2 mm thick lenses and bands of black, dark gray, and greenish gray colours; at the depth of 355 cm a horizontal layer of white bivalve fragments; viscous-plastic, massive; 380-385 cm: dark gray silty clay, with dendrithic inclusions of greenish gray sediment infilling worm burrows; dense, viscous-plastic; 385-413 cm: silty clay, laminated; lamination formed by intercalation of irregular lenses and bands of black, dark gray, gray, and greenish gray colours; black spots up to 3 mm in diameter; shell fragments at 405 cm; 413-430 cm: dark gray silty clay with worm-like and dendrithic texture formed by greenish gray 1-3 mm thick worm burrows; black sooty spots, viscous-plastic; 430-440 cm: silty clay, dark gray with empty tubes encrusted with iron hydroxides, their diameter is up to 10 mm and the thickness of the walls is 1-1.5 mm, in one of the tubes living worm was found; sediment is water-saturated, non-monolithic; 440-450 cm: silty clay, dark gray, with worm-like and dendrithic texture formed by greenish gray 1-3 mm thick worm burrows; black sooty spots, viscous-plastic; 450-473 cm: laminated silty clay, fine horizontal lamination formed by greenish gray and black lenses; dense, plastic; 473-480 cm: silty clay, dark gray, with empty tubes encrusted with iron hydroxides, their diameter is up to 10 mm and the thickness of the walls is 1-1.5 mm, in one of the tubes living worm was found; sediment is water-saturated, non-monolithic, forms cracks in the core section; Underlying sediments are drastically different in density: they are dense and dry 480-500 cm: silty clay, finely laminated, with small black spots, sub-horizontal lamination is formed by gray, greenish and black layers; 500-505, 512-520 cm: silty clay, dark gray with worm-like and dendrithic texture formed by greenish gray worm burrows; 505-512, 520-532 cm: silty clay, finely laminated, with small black spots, subhorizontal lamination is formed by gray, greenish and black layers; 532-540 cm: laminated silty clay, lamination formed by inclined layers and lenses up to 20-30 mm thick; 540-560 cm: silty clay, dark gray, with worm-like and dendrithic texture formed by greenish gray worm burrows; 560-589 cm: laminated silty clay, lamination formed by fine (1-2 mm) inclined layers and wavy lenses up to 10 mm thick; temperature of the sediment at the depth of 580 cm -1.7°C

Table 5 (continued): Sediment description, core IP07_2_006C

Date of coring - 14.09.07-15.09.07 **Water depth – 29.5 m** **Coordinates - 74^{O} 36.599 N; 129^{O} 54.757 E** **Total coring depth interval - 0-10.0 m**			
Core depth interval [cm]	**Coring cycle**	**Sediment thickness [cm]**	**Sediment description**
710-940	3	230	710-715 cm: clay, dark gray, homogeneous; 715-722 cm: clay, dark gray, spotty, with greenish gray inclusions formed by infilling of 1-3 mm thick worm burrows, worm-like texture; 722-735 cm: clay, black with rare greenish gray spots; 735-740 cm: clay, dark gray, spotty, with greenish gray inclusions formed by infilling of 1-3 mm thick worm burrows, worm-like texture; 740-747 cm: clay, black with rare greenish gray spots; 747-750 cm: clay, dark gray, spotty, with greenish gray inclusions formed by infilling of 1-3 mm thick worm burrows, worm-like texture; 750-770 cm: silty clay, laminated, lamination formed by greenish, gray, and black interlayers and lenses with a thickness of up to 2 mm, lamination is wavy and subhorizontal at the top, and inclined at the bottom; 770-860 cm: clay, dark gray with rare greenish gray spots (1-2 cm) and small black spots, shell fragments; in the lower part of the layer gray inclusions are up to 5 cm thick and form numerous branches stretching from one center; 860-880 cm: silty clay, laminated, intercalation of fine irregular black, dark gray, and greenish gray lenses, shell fragments; >880 cm: boundary< 880-890 cm: sandy silty clay, laminated, greenish gray and dark gray 20-40 mm thick layers with different content of clay and sand fractions; 890-903 cm: clay silt with black spots and lenses of black fine clayey sand; 903-915 cm: intercalation of inclined lenses and layers of silt, and fine sand, with very thin clay lenses >915 cm: boundary< 915-940 cm: fine sand, yellowish gray with tobacco-like colouring and brownish inclined wavy lenses with a thickness of 1 cm

II.2 TRANSDRIFT XIV

The TRANSDRIFT XIV expedition was carried out aboard RV “Ivan Petrov”. The expedition comprised a leg of the Russian 3-month expedition BARKALAV. TRANSDRIFT XIV started in Tiksi on September 5, 2008 and was successfully completed on September 21, 2008 when the “Ivan Petrov” entered Tiksi port again. 14 scientists from the AARI, AWI, IFM-GEOMAR, State Lena Delta Reserve and St. Petersburg State University (in cooperation with POMOR) took part (see Appendix „Lists of participating institutions and scientists“).

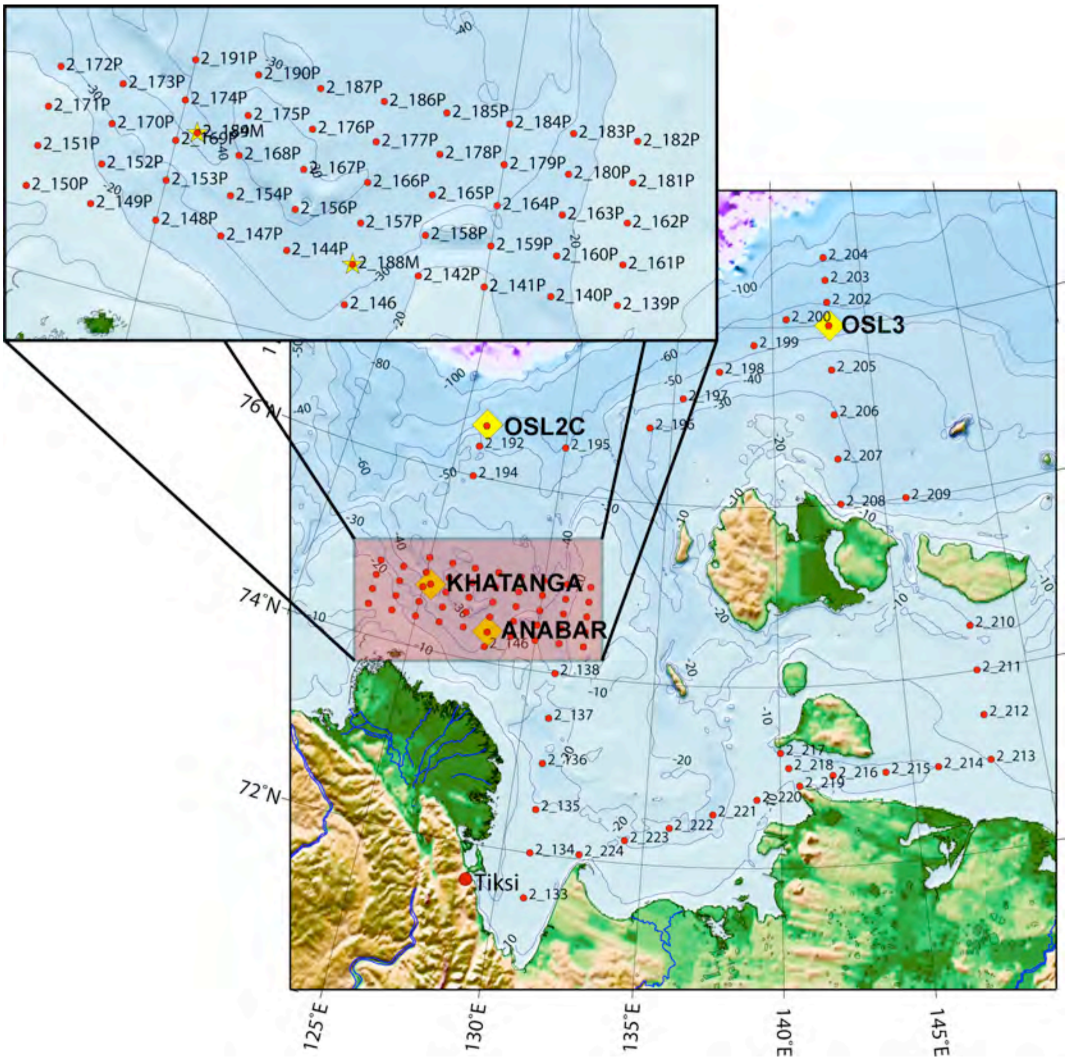


Fig. 29: Stations map of the TRANSDRIFT XIV expedition. Hydrographical and oceanographical stations are marked red. The positions of the seafloor observatories OSL2C, OSL3, KHATANGA and ANABAR are marked yellow. Further details on the stations can be found in the corresponding sections as well as in the complete station list in the appendix.

The research program during the expedition focused on studying the impact of climate change on the environment of the Siberian shelf seas, in particular the effects on processes in polynyas and frontal zones in the Laptev Sea. Regarding polynyas the data from the summer expeditions build the basis for the interpretation of the data obtained during the winter field campaigns. Observations during summer can prove the hypothesis that the winter processes also predetermine the physical, chemical, and biological processes that take place during the following spring and summer. The key working area of TRANSDRIFT XIV was a so called „polygone“ north of the Lena Delta (Fig. 29). Here the Laptev Sea polynya is active during winter and the important frontal zone between river water from the south and cold water masses from the north is dominating the environmental system during the summer months. During TRANSDRIFT XIV a multidisciplinary working program including physical oceanography, marine chemistry, sedimentology and biology was set up in order to cope with these tasks.

91 stations with multidisciplinary investigations were carried out in the Laptev and East Siberian seas (Fig. 29). Two oceanographic seafloor observatories, which had been deployed during the TRAMNSDRIFT XII expedition in summer 2007, were successfully recovered and re-deployed equipped with SCOUTS (satellite connected oceanographic up-turning transmitting system) (Fig. 30). The SCOUTS are planned to record the data from all sensors of the seafloor observatories. Thus, the data are stored additionally and will be sent to a so-called pop-up buoy at certain intervals. This buoy will surface when there is no ice cover above the observatory and send the data via Iridium satellite to the OSL. It is planned to transfer the data four to five times in 2009.

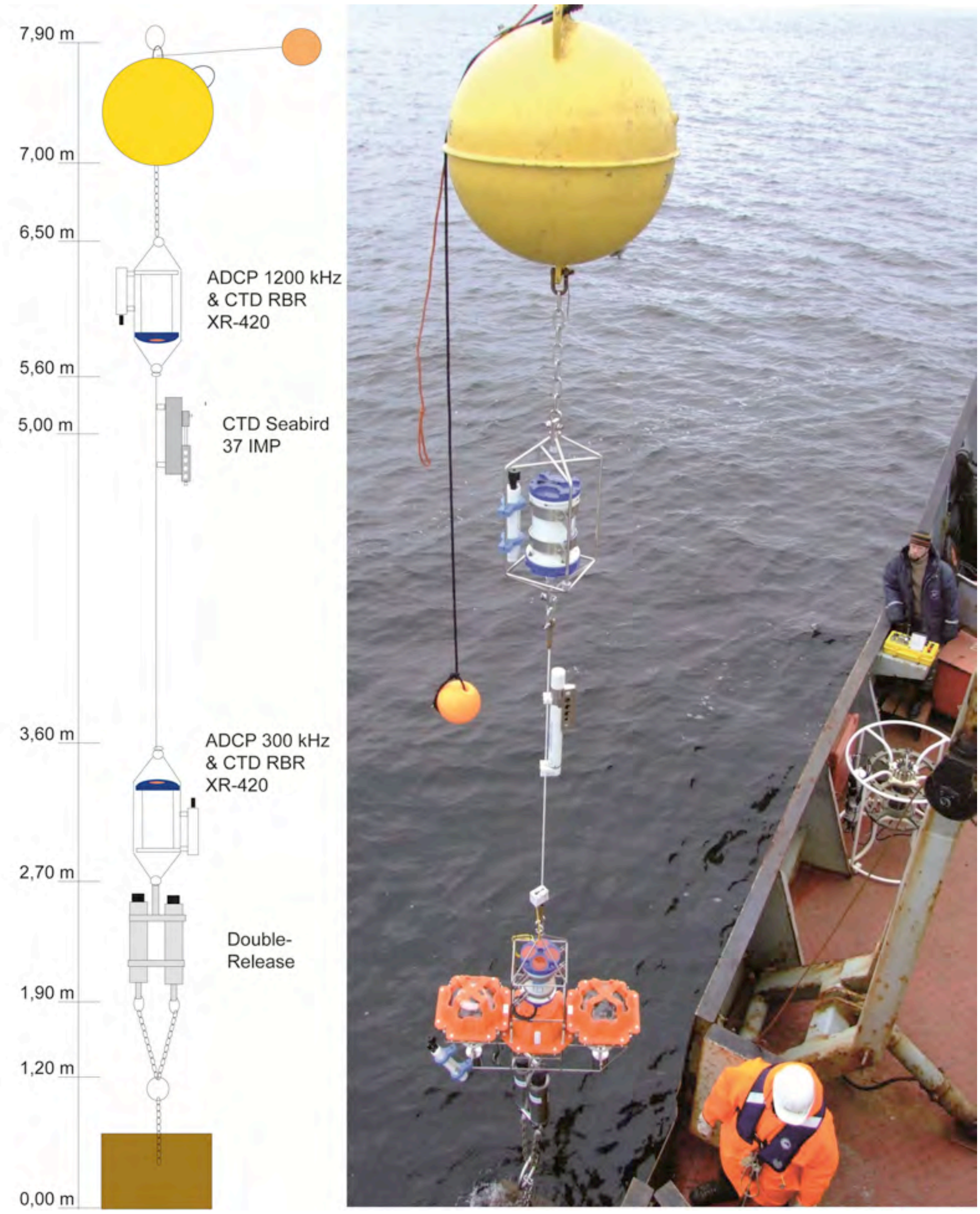


Fig. 30: Design of the seafloor obervatories ANABAR and KHATANGA with SCOUTS deployed north of the Lena Delta during TRANSDRIFT XIV.

The primary objective of the seafloor observatories ANABAR und KHATANGA was to study the seasonal variabilty in temperature, salinity and currents as well as the ice conditions and transport processes. To study shelf-basin interactions on the outer shelf of the Laptev Sea the seafloor observatories OSL2c and OSL3 were deployed (Fig. 29).

During TRANSDRIFT XIV the weather conditions were good (Fig. 31) and the Laptev Sea was ice-free (Fig. 32). Only two days were lost because of severe weather conditions during the second part of the expedition.

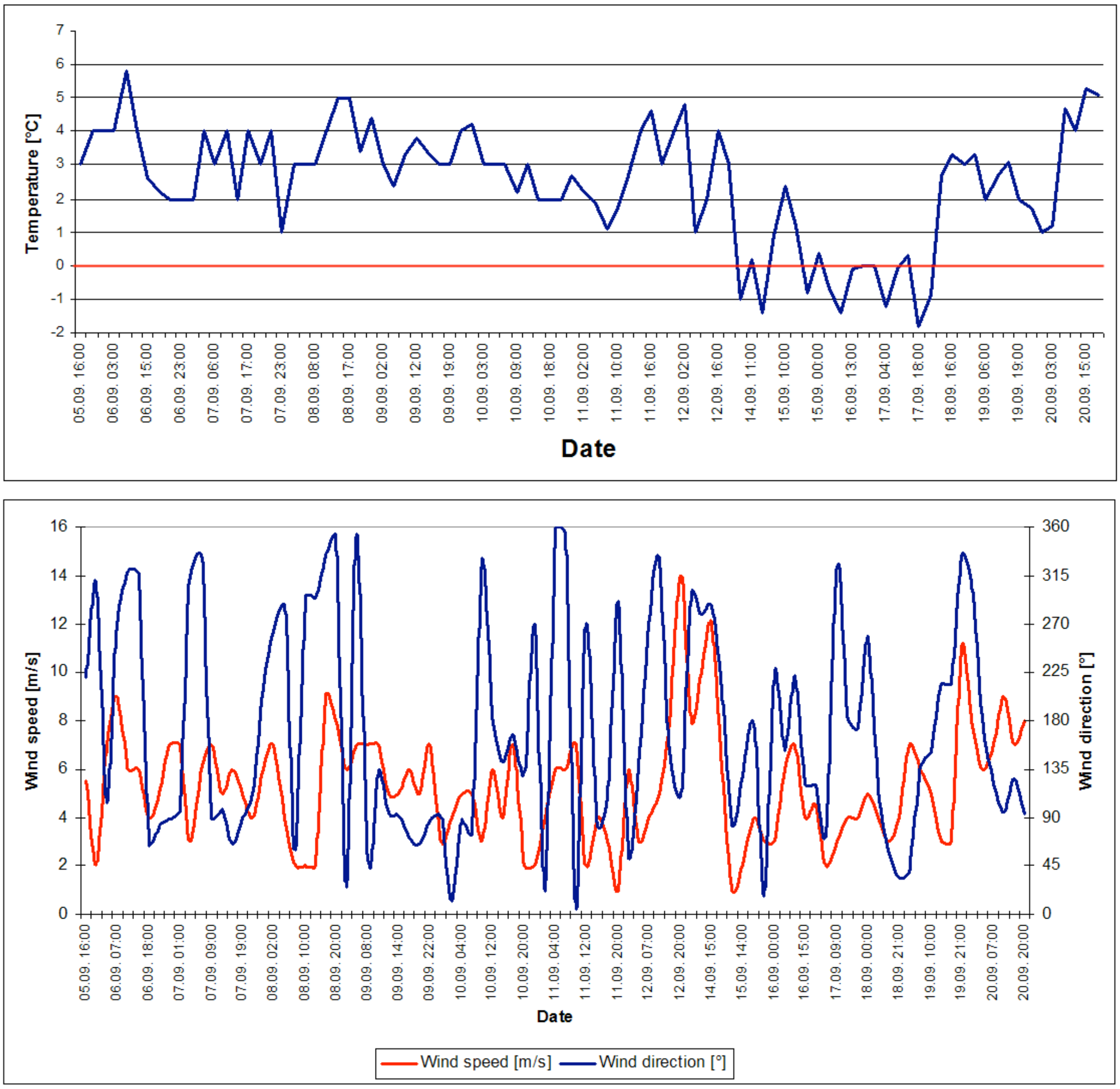


Fig. 31: Temperature (upper panel) and wind conditions (lower panel) during TRANSDRIFT XIV, measured with the ship's meteorological equipment between September 5 and 20, 2008.

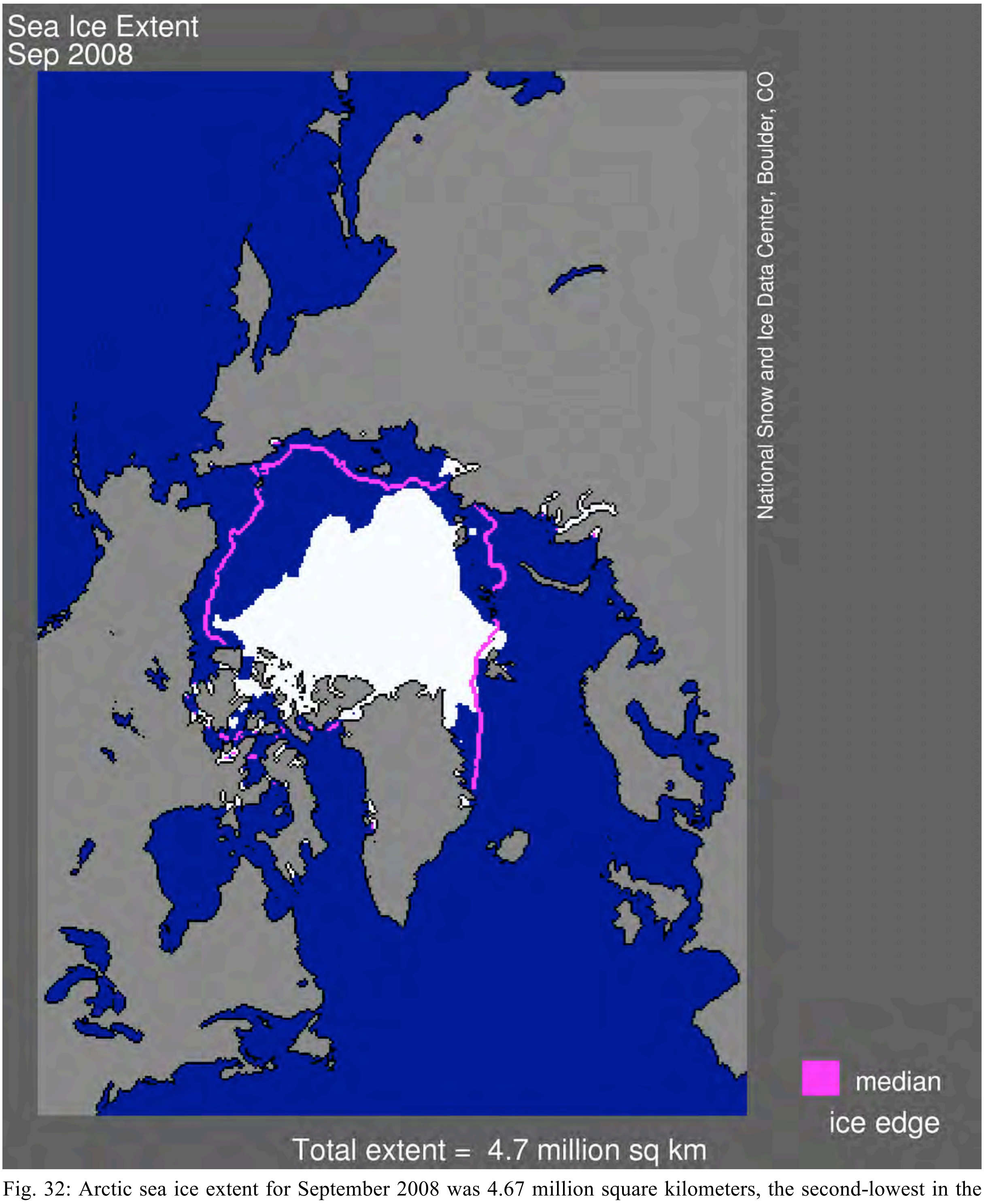


Fig. 32: Arctic sea ice extent for September 2008 was 4.67 million square kilometers, the second-lowest in the satellite record. The magenta line shows the median ice extent for September from 1979 to 2000. The 2008 September low was 34% below the long-term average from 1979 to 2000 and only 9% greater than the 2007 record.

Physical oceanography

J. Hoelemann[1], A. Novikhin[2], T. Klagge[3], L. Ermakova[4]
[1]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
[2]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[3]Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany
[4]P.P. Shirshov Institute of Oceanology RAS, Moscow, Russia

During the 2008 cruise the extensive oceanographic survey of the previous year was repeated at 92 stations in the Laptev and East Siberian seas (Fig. 33). Since the positions of the oceanographic stations were the same as in 2007 the data can be directly compared.

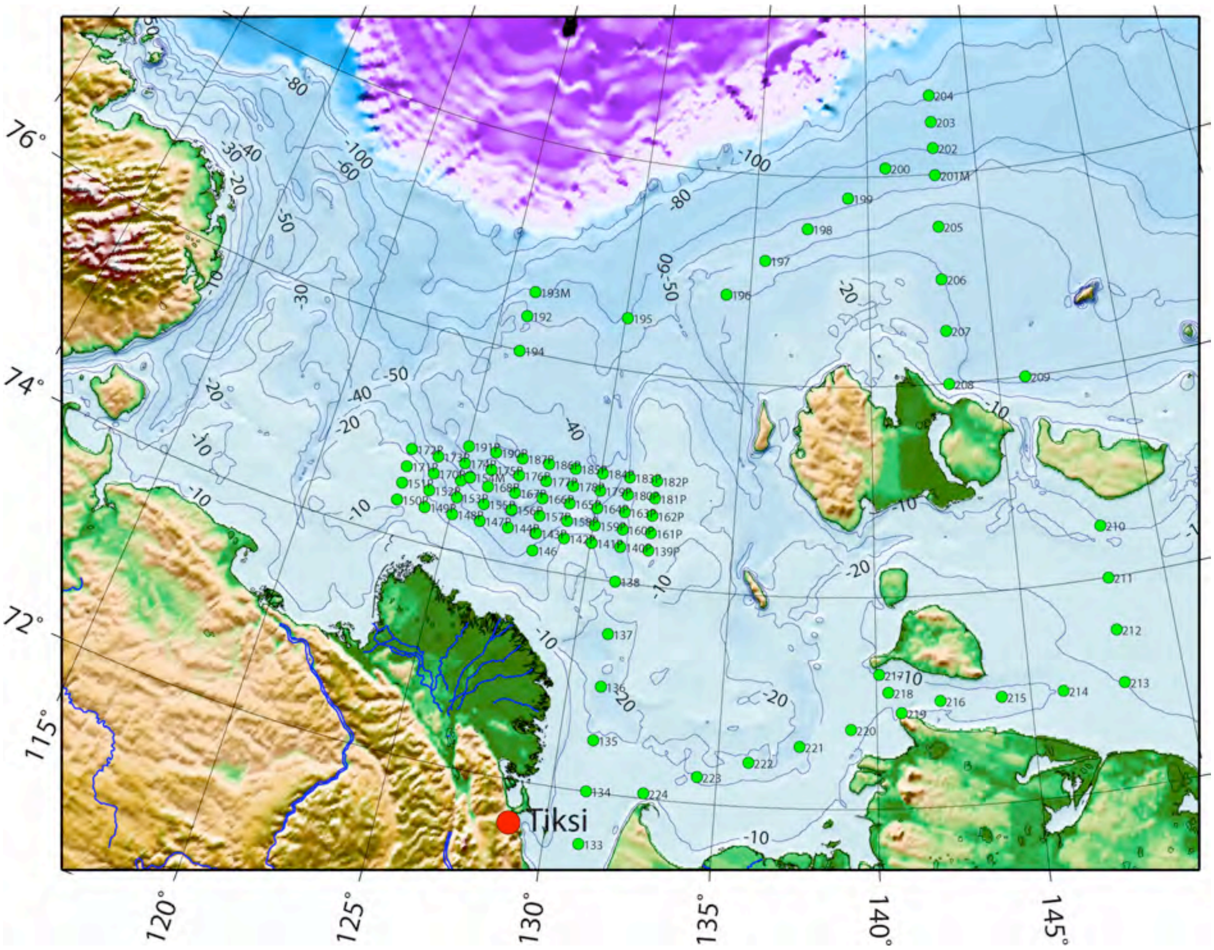


Fig. 33: CTD profiles that were carried out during TRANSDRIFT XIV.

Methods and equipment

Complementary high resolution measurements of the water column were carried out near the seafloor observatories, in a narrow-spaced survey north of the Lena Delta and along profiles across the shelf. The oceanographic observations included temperature, salinity, chlorophyll, oxygen and turbidity measurements by means of a Seabird 19+ CTD with additional sensors that were mounted on a carousel water sampler.

Investigations at oceanographic stations included water probing and sampling with the use of the following equipment: CTD (Conductivity, temperature, depth) probe SBE 19 plus attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module) (Fig. 34). The rosette operates offline, i.e. the operational control and data transfer are maintained without a cable. Maximum operational depth is 6,800 m.

Fig. 34: CTD probe SBE 19+ attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module).

The release for automatic opening of water-sampling bottles at certain depth levels, Carousel Auto-Fire Module (AFM), includes microprocessor, semi-conductor memory, RS-232 interface, and batteries. The device records the hydrostatic pressure real-time measurements transferred by the probe and closes the sampling bottles at certain water depth levels. Also, the AFM records the sequence of bottle closures in its own memory: number, time, closure verification, and 5 CTD scans for every closed water-sampling bottle.

AFM power supply is maintained by 9 batteries Duracell MN1300 (LR20) allowing for about 40 hours of work or by nickel-cadmium batteries.

The oceanographic probe SBE 19plus SEACAT Profiler produced by Sea-Bird Electronics, Inc., USA, measures the following characteristics of seawater: temperature, conductivity, and hydrostatic pressure (Fig. 35). The measurement ranges are -5 to 35 °C for temperature, 0 to 9 cm/m for conductivity, and 0 to 600 m for hydrostatic pressure (maximum operational depth). The accuracy is 0.005°C for temperature, 0.0005 cm/m for conductivity, and 0.1% of the total measurement range for the hydrostatic pressure. Stability (monthly) of the temperature sensor is 0.0002 °C, that of the conductivity sensor is 0.0003 cm/m, and of the hydrostatic pressure sensor 0.004 % of the total measurement range. Resolution for temperature measurements is 0.0001 °C, for conductivity measurements 0.00001 cm/m for freshwater, 0.00005 cm/m for seawater, and 0.00007 cm/m for highly saline water, and for hydrostatic pressure measurements 0.002 % of the total measurement range. The frequency of along-transect measurements is 4 scans per second (4 Hz).

The probe is equipped with a fixed memory of 8 Mb recording the measurement results. The interface is RS-232C. Power supply is maintained either by 9 batteries Duracell MN1300 (LR20) allowing for 60 hours of profiling or nickel-metalhydride or nickel-cadmium batteries. Information is downloaded from the fixed memory after the end of measurements with the help of standard cable and software. Remote data downloading is not possible for this probe.

Metrological characteristics are under control of the operating company.

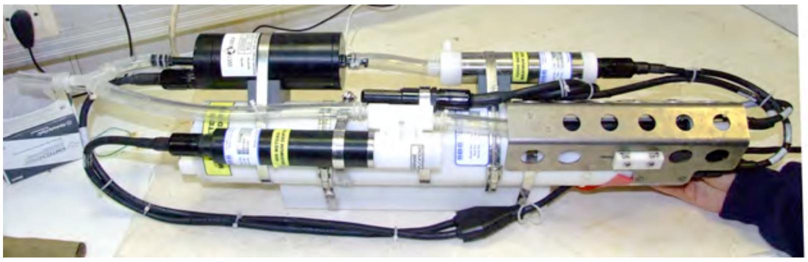


Fig. 35: Oceanographic probe SBE 19plus SEACAT Profiler equipped with sensors for measuring water turbidity, dissolved oxygen concentration and fluorescence.

The probe is equipped with additional sensors produced by Sea-Bird Electronics, Inc., USA, for measuring water turbidity, dissolved oxygen concentration and fluorescence.

Table 6 shows the sampling rate and accuracy of the instruments. The exact positions of each station can be found in the complete sampling list in the appendix.

Table 6: Details for all instruments on carousel water sampler

Instrument	Producer	Sampling rate	Accuracy
Conductivity sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.0005 S/m
Temperature sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.005 °C
Pressure sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.1% of full scale range
Turbidity sensor	Seapoint	4 Hz	<2% deviation for 0-750 FTU
Oxygen sensor SBE43	Seabird Electronics, USA	4 Hz	2% of saturation

<u>First results</u>

A comparison of the salinity and temperature data of the TRANSDRIFT XII (2007) and TRANSDRIFT XIV (2008) expeditions revealed that the hydrography of the Laptev Sea differed significantly in these years. While the salinity data in 2007 showed low values (<15) in the surface waters of the southeastern Laptev Sea and higher salinities (>20) in the central Laptev Sea, thus indicating an eastward advection of the freshwater plume of the Lena River, the salinity distribution in 2008 gave evidence that the river plume was advected northward. This resulted in low surface salinities (<15) in the central Laptev Sea between 74° and 75°N (Figs. 36 and 37). In addition and also in contrast to the situation observed in 2007, the surface temperatures in the eastern and central Laptev Sea in 2008 were 2°-3°C lower (Figs. 36 and 38), and therefore close to the long-term mean (based on the 1920-2008 AARI data set). The hydrographic conditions observed during September 2008 were most probably caused by the prevailing atmospheric forcing with wind blowing from easterly directions, thus advecting the freshwater plume of the Lena River to northwest.

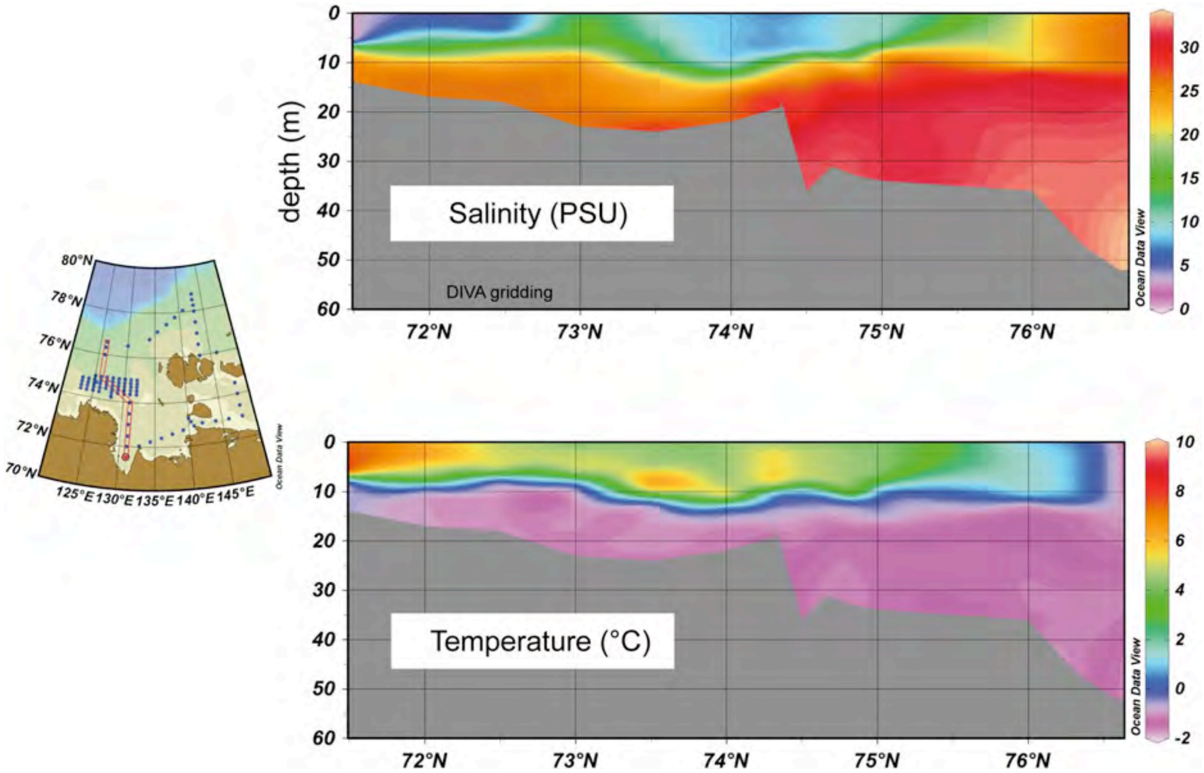


Fig. 36: Salinity and temperature profile across the Laptev Sea shelf recorded during the TRANSDRIFT XIV expedition in September 2008. The data clearly show the distinct stratification of the water column.

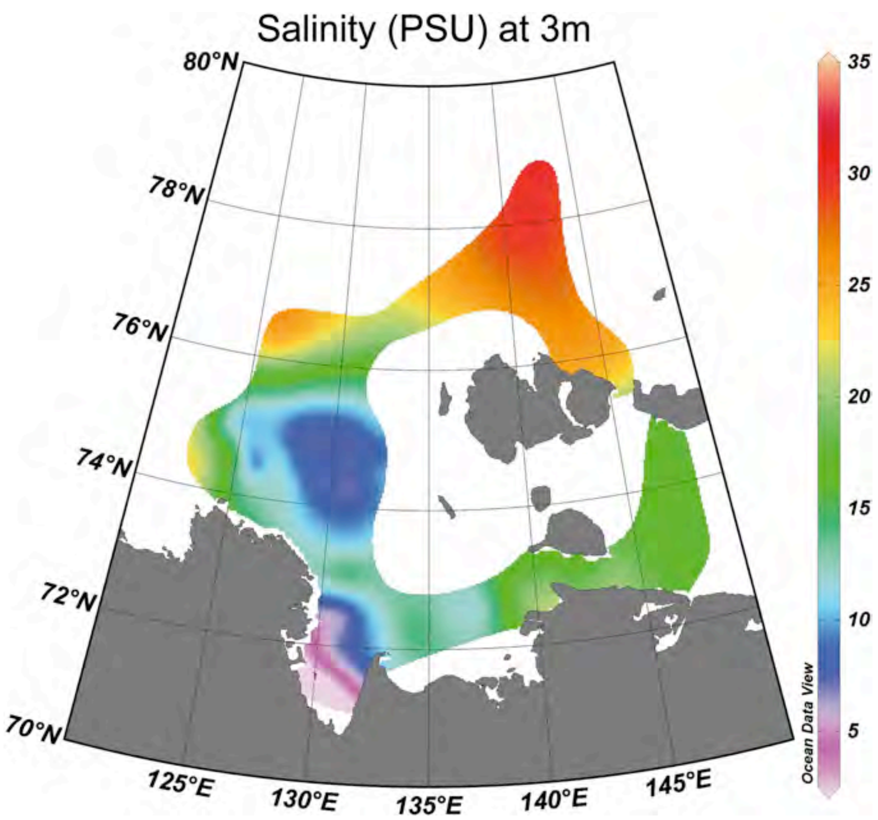


Fig. 37: Salinity (PSU) in the surface layer (averaged between 2.5m and 3.5m water depth) during the TRANS-DRIFT XIV expedition in September 2008. The Lena river plume was advected to the north resulting in low salinities in the surface layer between 74°N and 76°N (gridding based on sampling locations shown in Fig. 33).

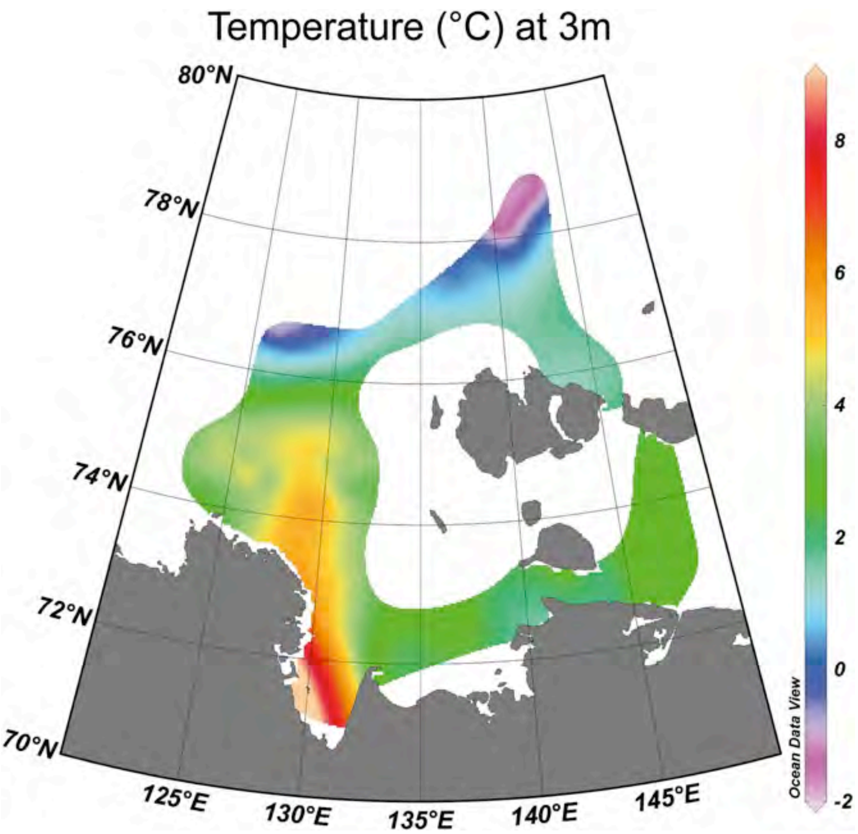


Fig. 38: Water temperature (°C) in the surface layer (averaged between 2.5m and 3.5m water depth) during the TRANSDRIFT XIV expedition in September 2008. Near-surface water temperatures were lower than in 2007 and close to the long-term average for this season (gridding based on sampling locations shown in Fig. 33).

Seafloor observatories

T. Klagge
Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

Two year-round seafloor observatories (KHATANGA and ANABAR) were recovered and redeployed north of the Lena Delta on the mid-shelf of the Laptev Sea (Fig. 39). The primary objective was to study the seasonal variability in the temperature and salinity, the current system, and the transport processes as well as to monitor the ice conditions. In addition two seafloor observatories (OSL2c and OSL3) were deployed on the outer shelf in order to study the shelf-basin interaction in the Siberian Arctic.

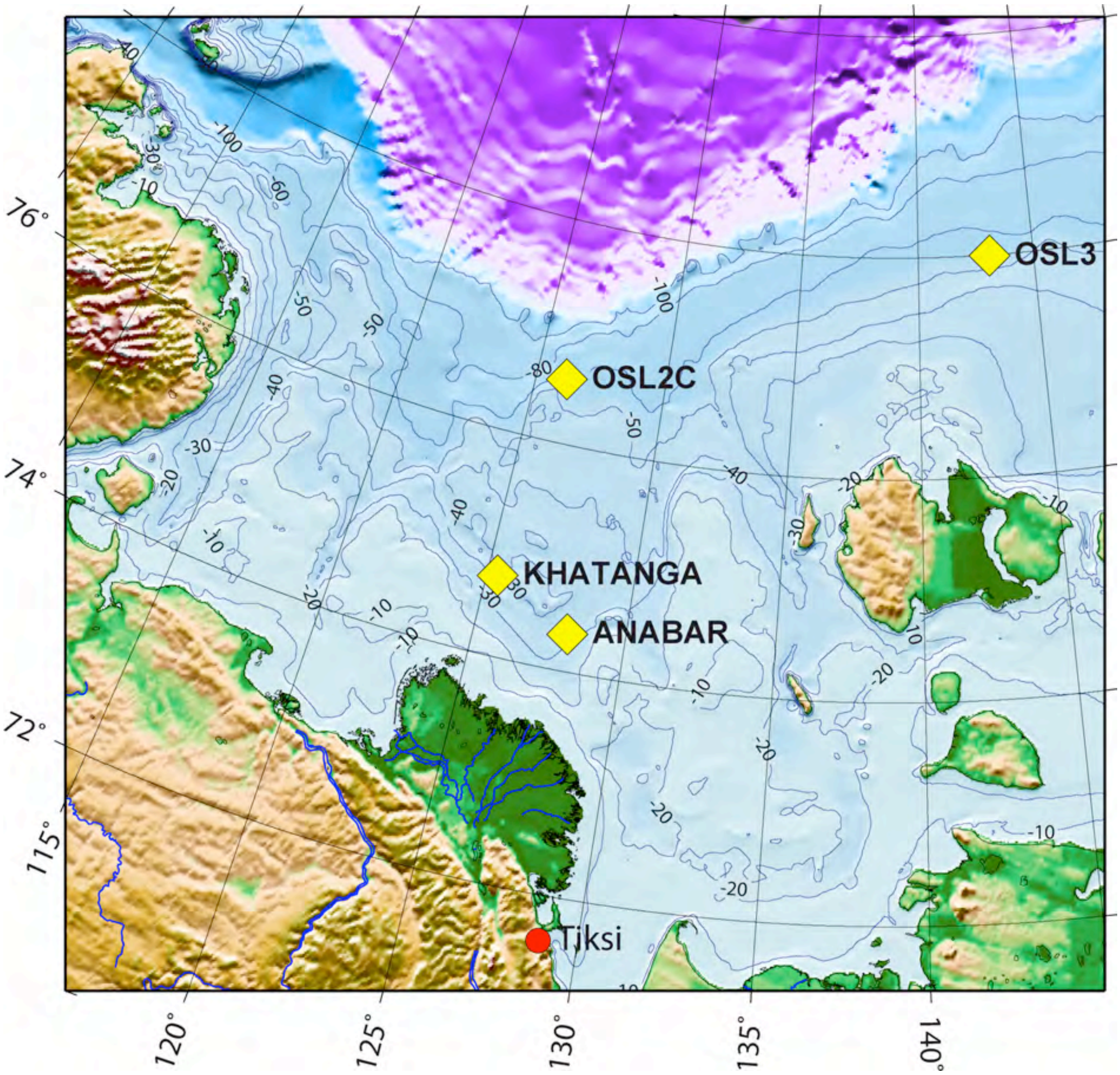


Fig. 39: Recovered and deployed seafloor observatories during TRANSDRIFT XIV.

ANABAR (Fig. 40)

Deployed: 2008-09-12, 06:20 UTC
Position GPS60: 74° 19.863'N, 128° 00.385'E; Decimal: N74.33104°, E128.00642°
Depth: 33 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9271
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I;
  Memory: 64 Mbyte Flash-memory
  Serial: 9207
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14606
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14605
- CTD Seabird 37 IMP
  Memory: 2 Mbyte Flash-memory
  Serial: 37IMP46569-5388
- SCOUTS System
  Central processing unit (SE) serial: 002
  Popup-Buoy 1 serial: 020
  Popup-Buoy 2 serial: 021
- Release IXSEA OCEANO 2500
  Serial: 002
- Release IXSEA OCEANO 2500
  Serial: 003

Sampling:

- the ADCPs are programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE37IMP is programmed to take a full sample (= pressure, temperature, conductivity) every 15 minutes
- the CTDs from RBR are both programmed to take a full sample (= temperature, conductivity, turbidity) every 30 minutes

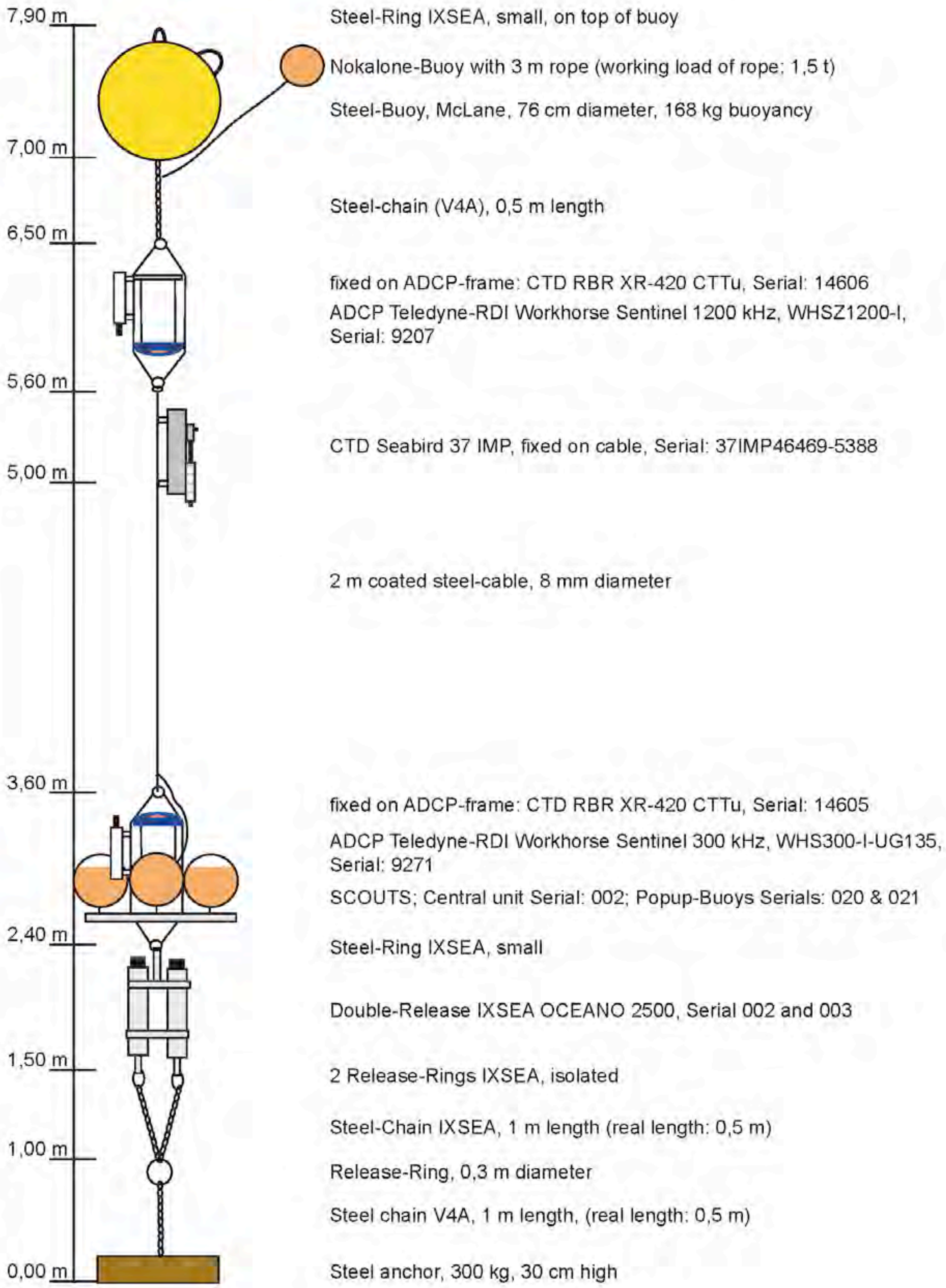


Fig. 40: Design of the seafloor observatory ANABAR, deployed on September 12, 2008.

KHATANGA (Fig. 41)

Deployed: 2008-09-12, 12:30 UTC
Position GPS60: 74° 42.865'N, 125° 17.343'E; Decimal: N74.71441°, E125.28905°
Depth: 43 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9226
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I;
  Memory: 64 Mbyte Flash-memory
  Serial: 9208
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14604
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14607
  Attention: without turbidity sensor!
- SCOUTS System
  Central processing unit (SE) serial: 001
  Popup-Buoy 1 serial: 008
  Popup-Buoy 2 serial: 009
- CTD Seabird 37 IMP
  Memory: 2 Mbyte Flash-memory
  Serial: 37IMP46569-5387
- Release IXSEA OCEANO 2500
  Serial: 004
- Release IXSEA OCEANO 2500
  Serial: 005

Sampling:

- the ADCPs are programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE37IMP is programmed to take a full sample (= pressure, temperature, conductivity) every 15 minutes
- the CTDs from RBR are both programmed to take a full sample (= temperature, conductivity, turbidity) every 30 minutes; the topmost RBR-sensor (#14607) does not have a turbidity sensor, so it only samples temperature and conductivity

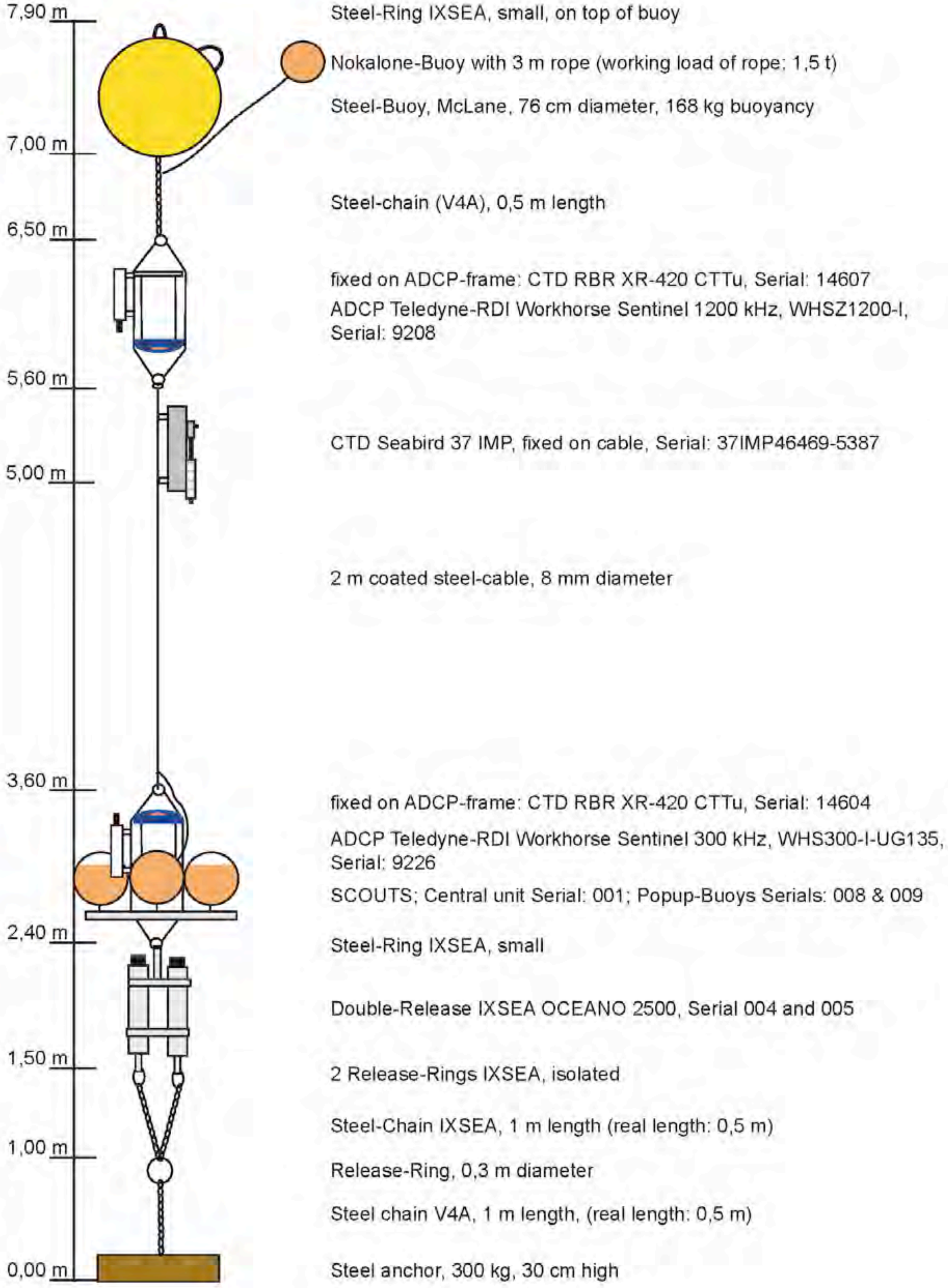


Fig. 41: Design of the seafloor observatory KHATANGA, deployed on September 12, 2008.

OSL2C (Fig. 42)

Deployed: 2008-09-14, 09:50 UTC
Position GPS60: 76° 34.239'N, 126° 05.096'E; Decimal: N76.57065°, E126.08493°
Depth: 55 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300 (with 4 flotation balls)
  Memory: 64 Mbyte Flash-memory
  Serial: 567
- RBR XR-420 Turbidity sensor
  Memory: 8 Mbyte Flash-memory
  Serial: 10019
- CTD Seabird SBE37SMP
  Memory: 8 Mbyte Flash-memory
  Serial: 5663
- Release IXSEA OCEANO RT 861 B1S
  Serial: 490

Sampling:

- the ADCP is programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE37SMP is programmed to take a full sample (= pressure, temperature, conductivity) every 15 minutes
- the RBR-logger is programmed to take a sample (= turbidity) every 15 minutes

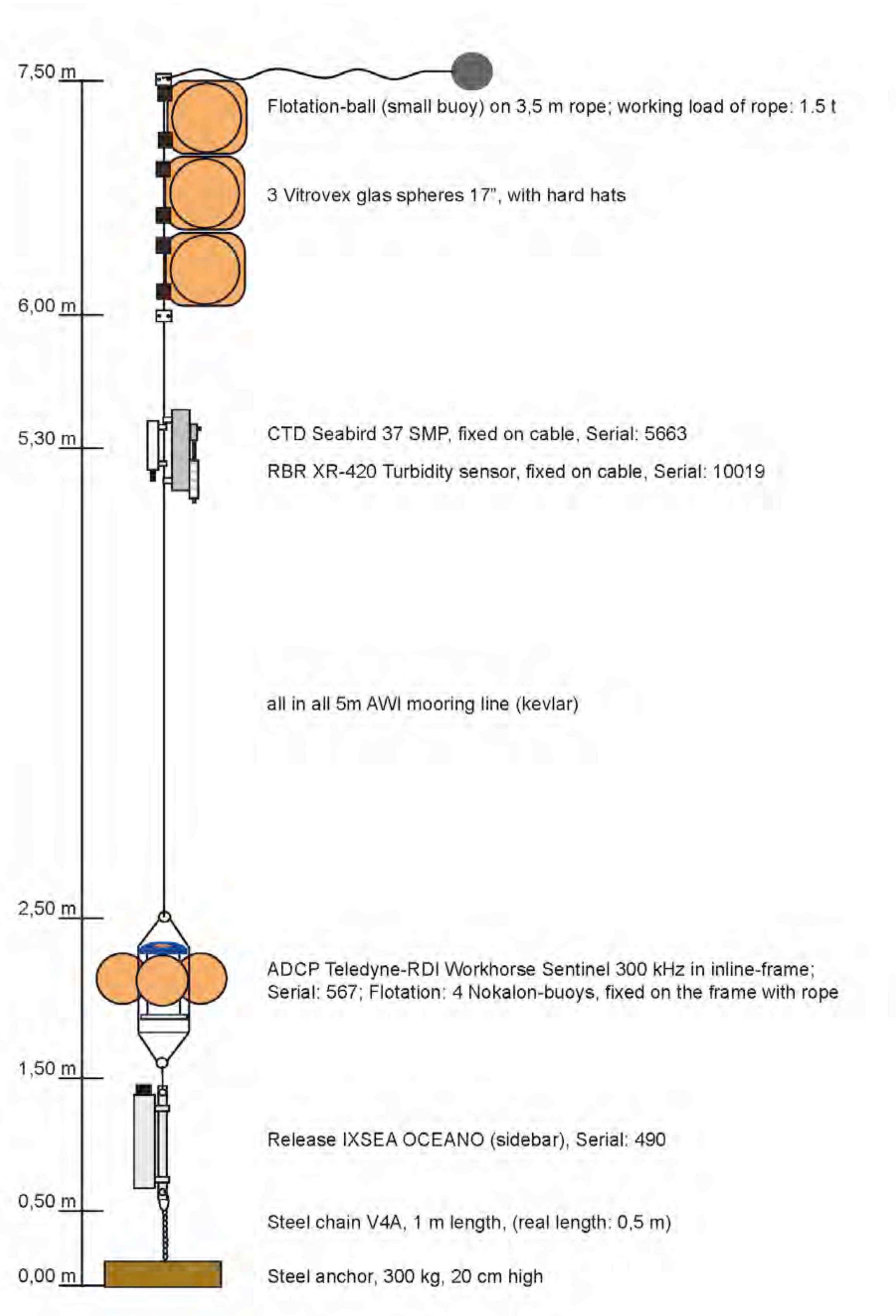


Fig. 42: Design of the seafloor observatory OSL2C, deployed on September 14, 2008.

OSL3 (Fig. 43)

Deployed: 2008-09-16, 09:35 UTC
Position GPS60: 77° 59.255'N, 143° 00.534'E; Decimal: N77.98758°, E143.00890°
Depth: 49 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG133
  (in Flotec-frame);
  Memory: 64 Mbyte Flash-memory
  Serial: 7944
- CTD Seabird SBE 16plus
  Memory: 8 Mbyte Flash-memory
  Serial: 16P39298-4812
- Release IXSEA OCEANO RT 861 B1S
  Serial: 448

Sampling:

- the ADCP is programmed to take a full sample (= direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE16plus is programmed to take a full sample (= pressure, temperature, conductivity, turbidity) every 15 minutes

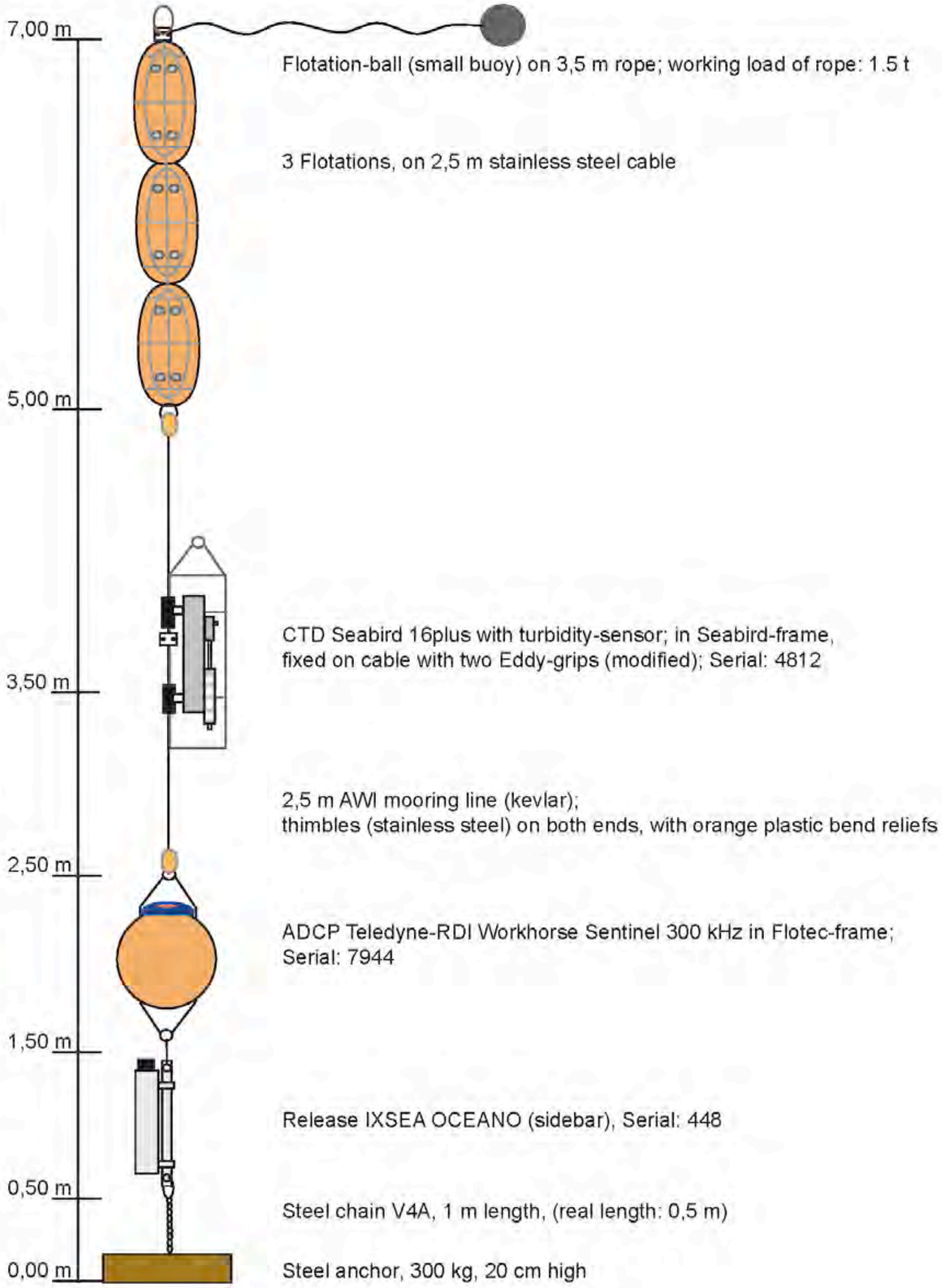


Fig. 43: Design of the seafloor observatory OSL3, deployed on September 16, 2008.

Marine chemistry

A. Novikhin[1], J. Hoelemann[2]
[1]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[2]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany

The Arctic Ocean is the most riverine-influenced of all of the world's oceans. Despite this, the importance of riverine nutrients for the Arctic Ocean is generally poorly understood. The concentrations of inorganic nutrients in Arctic rivers are among the lowest worldwide (inorganic nitrogen: 0-20 µM; phosphate: 0.08 µM), with the exception of silicate in some rivers (0.5-110 µM) (Dittmar & Kattner, 2003). Also the Laptev Sea is characterized by low nitrogen and phosphate concentrations in the surface layer (Pivovarov et al., 2006; Anderson et al., 2009), which results in a generally low primary production (Tuschling, 2000). Near the Lena Delta terrestrial and marine organic particles sink through the pycnocline where they are partly remineralized through microbial degradation. This process leads to the consumption of oxygen and an increase of inorganic nutrients in near-bottom waters of the southeastern Laptev Sea. While the concentration of inorganic nutrients increases with depth, all components of dissolved organic matter (DOM) decrease (Kattner et al., 1999). A good proxy for the distribution of DOM in the water column is the optical measurement of the color of water at a specific wavelength (CDOM, chromophoric organic matter or gelbstoff). Because of the differences in water chemistry between the surface and the near-bottom layer, the vertical distribution of nutrients and CDOM can be used as a tracer for studying physical oceanographic processes like vertical mixing.

The working program of the TRANSDRIFT XIV expedition also included investigations of water mass formation during winter (i.e., brine formation) and the impact of these waters on the hydrography of the Laptev Sea. The study is carried out on the basis of the oxygen isotope composition ($\delta^{18}O$) of the water in conjunction with hydrological data. River water in the Arctic is highly depleted in $\delta^{18}O$ relative to marine waters and the effect of sea-ice melting or formation on the water column can be separated from these two sources since sea-ice processes strongly influence salinity whereas the $\delta^{18}O$ signal remains nearly unaltered. On this basis winter brine production can be quantitatively evaluated based on $\delta^{18}O$ and salinity data obtained during the summer expedition.

Methods

During the expedition, water samples for chemical analyses were taken at 32 stations on standard depth levels (Fig. 44) by means of a carousel water sampler (Seabird 32C) with attached 5 l Niskin water samplers that were closed automatically by an Auto Fire Module (AFM, Seabird) at preset water depths. 147 samples for the analysis of phosphate, nitrite and nitrate were stored frozen at -20°C in HDPE bottles and analyzed in the OSL in St. Petersburg by means of a SKALAR segmented flow analyzer. The photometric analysis of silicate (147 samples) was performed on board immediately after sampling. The concentration of dissolved oxygen was measured on board in 170 samples. 46 samples for CDOM and 200 samples for $\delta^{18}O$ were collected. For CDOM the samples were taken from top and bottom levels only. One set of CDOM samples was immediately frozen after sampling at the temperature -20°C. A second set of samples was filtered (0.1 µm pore size) and stored in a cool place. CDOM will be analyzed in the OSL. The $\delta^{18}O$ samples were taken in dark glass bottles with wax-sealed covers and analyzed at the Leibniz Laboratory for Radiometric Dating and Isotope Research (Kiel, Germany) applying the CO_2 water isotope equilibration technique on a Finnigan gas bench II unit coupled to a Finnigan DeltaPlusXL mass spectrometer.

0.5 litre water samples were filtered (0.45 µm pore size) to determine the concentration of suspended matter in the water column and to calibrate the optical backscatter sensor of the CTD.

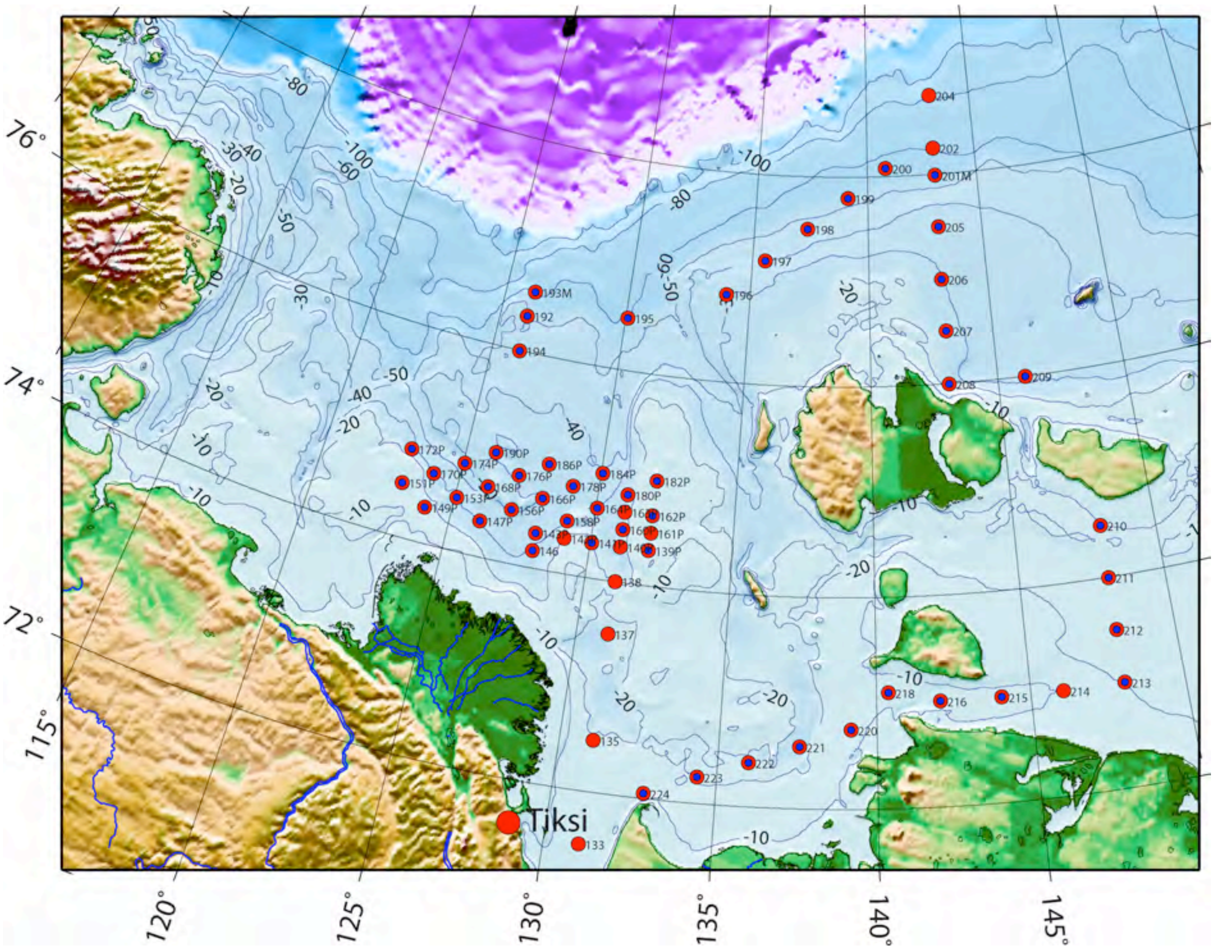


Fig. 44: Map showing all stations where samples for marine chemistry and the concentration of suspended particulate matter were taken during TRANSDRIFT XIV: oxygen, inorganic nutrients and CDOM (red), $\delta^{18}O$ (blue).

First results

Like the general hydrography observed in September 2008 also the vertical and horizontal distribution of inorganic nutrients showed a pattern that is similar to the long-term mean (based on AARI data from 1964 until 2003). A cross-shelf profile of salinity, temperature, dissolved oxygen, and nutrients representative for the situation observed in 2008 is shown in Figure 45. The most obvious difference in the water chemistry between 2008 and the long-term average was the existence of an intermediate maximum oxygen layer (up to 9 ml/l) at a depth of 12-15 m. This high-oxygen water mass was also characterized by low silicate and chlorophyll concentrations. The origin of this water mass is most likely linked to the ice north of the stations but the mechanism of formation is still unclear. An oxygen-depleted water mass (less than 6 ml/l) was observed in the near-bottom waters in the southern part of the transect along 126° E. This water mass showed also higher nutrient concentrations (silicates up to 30 µmol/l, and phosphates up to 0.8 µmol/l). Low oxygen concentrations (5.7-6.0 ml/l) in near-bottom waters north of the Lena Delta were also observed during the winter expedition in March/April 2008 (TRANSDRIFT XIII). This provides an indication that 1. the near bottom waters in vicinity to the Lena Delta were strongly affected by microbial degradation of organic matter and 2. that no major mixing event ventilated the near-bottom water between April and September 2008.

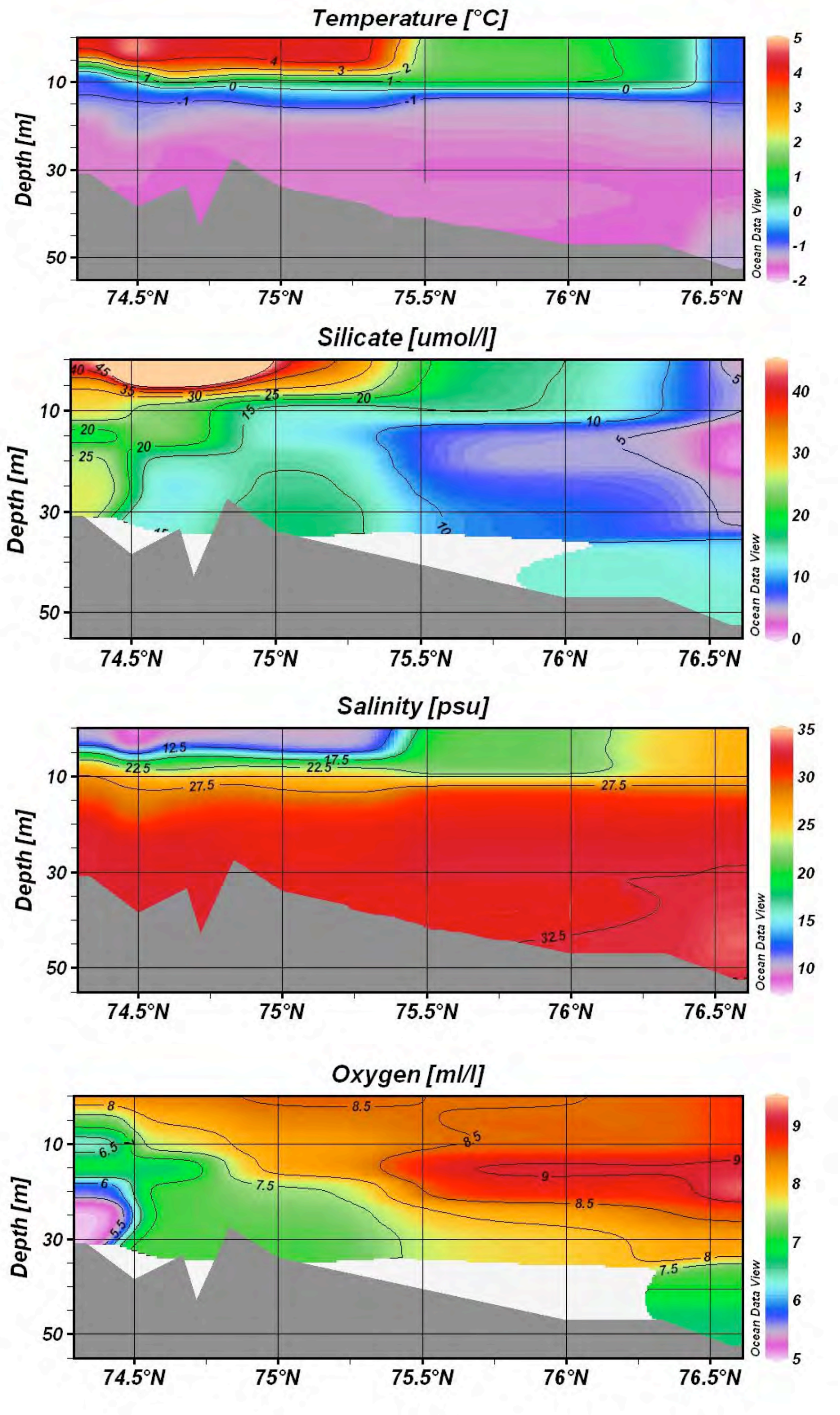
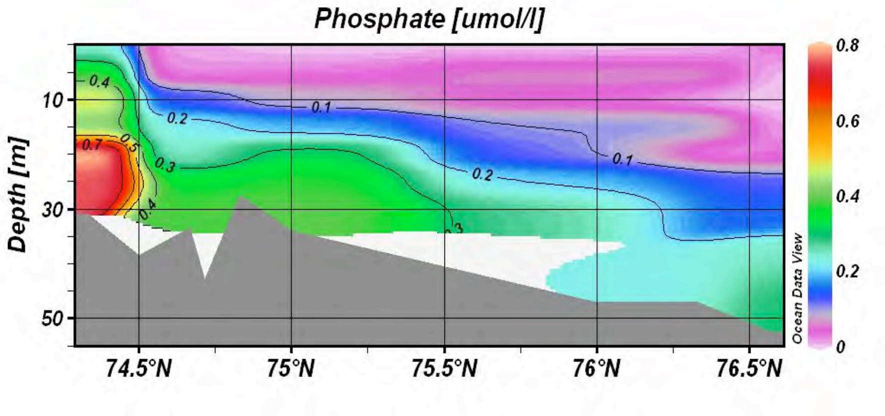


Fig. 45: Vertical distribution of temperature, salinity, dissolved oxygen and nutrients on a NS running transect along 126° E, September 2008 (continued on next page).



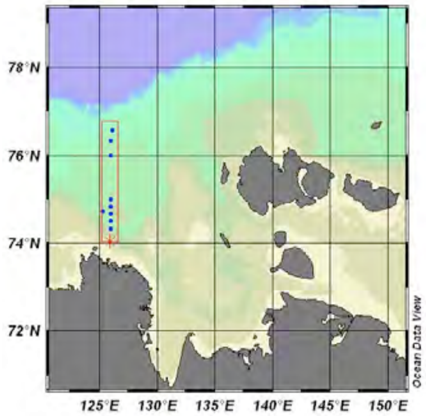


Fig. 45 (continued): Vertical distribution of temperature, salinity, dissolved oxygen and nutrients on a NS running transect along 126° E, September 2008.

During the summer cruises, several stations were carried out in the East Siberian Sea one of the least investigated shelf region in the Arctic. In 2008 a NS running transect at 143°E that was carried out already in 2007 was repeated (Fig. 46). In comparison to 2007, the surface temperatures recorded were lower and salinity was higher causing a less pronounced density stratification. Dissolved oxygen concentrations are similar to those reported in September 2007, but an intermediate oxygen maximum as in 2007 was not observed. We assume that this is due to the lower surface water temperature in combination with mixing between the intermediate and surface water layers. A high-oxygen surface water layer (8.5-9.0 ml/l) was observed in the northern part of the profile close to the position of the sea ice margin. Near-bottom water masses from the East Siberian Sea showing low oxygen and high nutrient concentrations were found on the southern end of the transect along 143°E (Fig. 46).

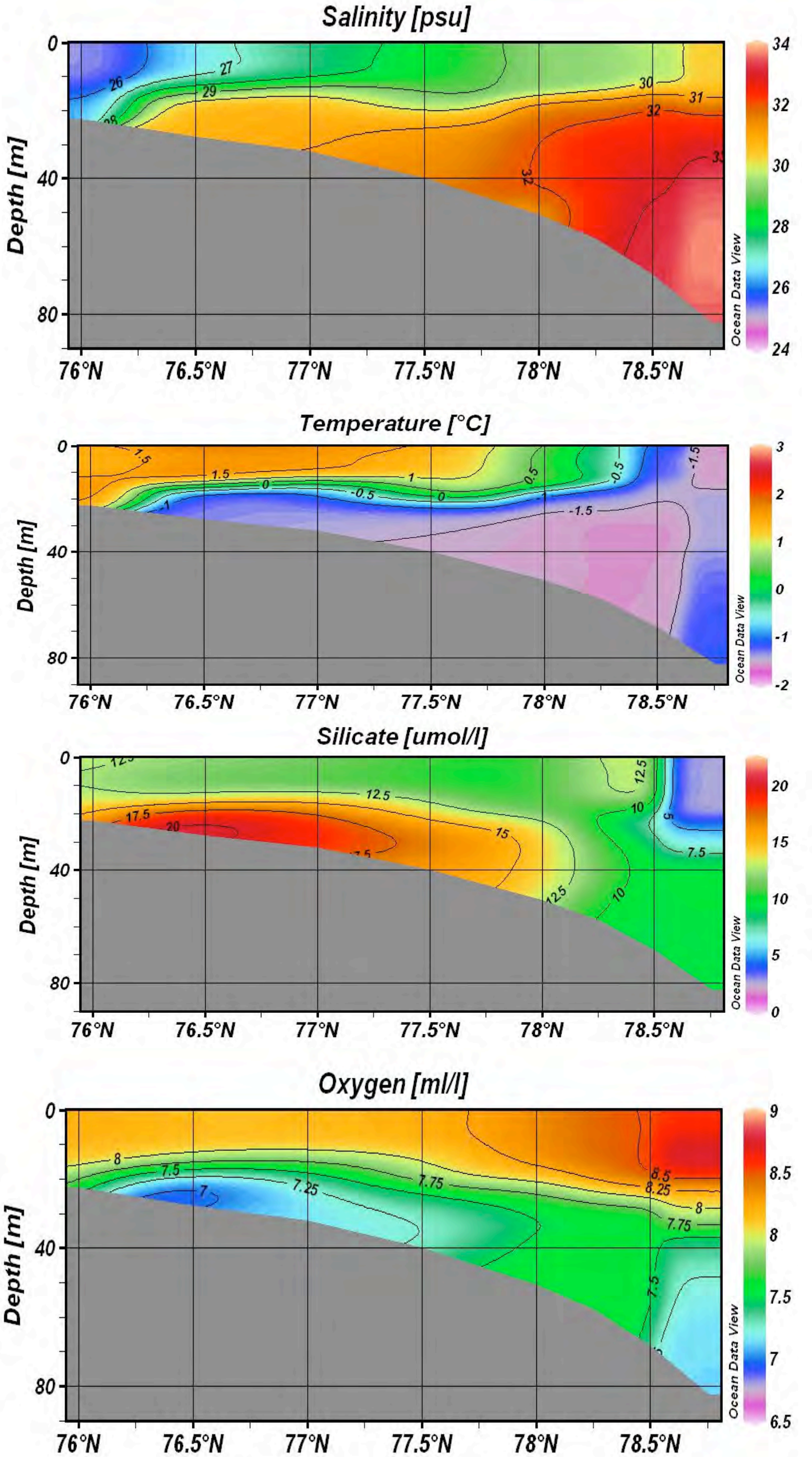


Fig. 46: Vertical distribution of temperature, salinity, nutrients and dissolved oxygen on a NS running transect along 143° E, September 2008 (continued on next page).

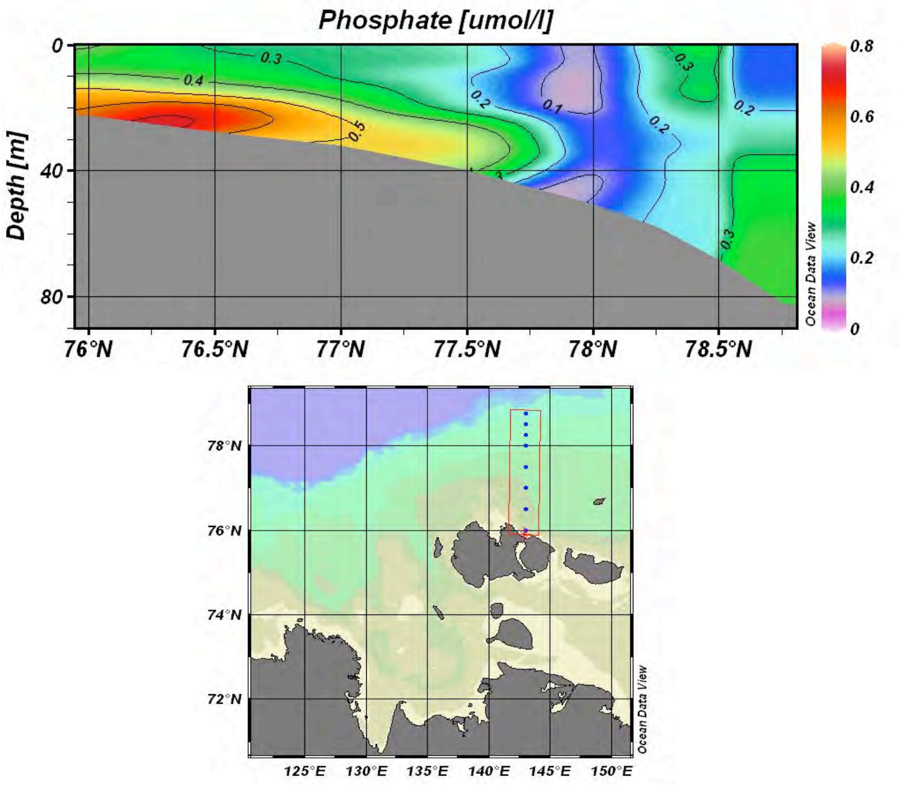


Fig. 46 (continued): Vertical distribution of temperature, salinity, nutrients and dissolved oxygen on a NS running transect along 143° E, September 2008.

II.3 Biological investigations: TRANSDRIFT XII and XIV

E. Abramova[1], F. Martynov[2], D. Taborskiy[2], I. Vishnyakova[2], L. Astakhova[3]
[1]State Lena Delta Reserve, Tiksi, Russia
[2]Biological Faculty, St. Petersburg State University, St. Petersburg, Russia
[3]Biological Faculty, Moscow State University, Moscow, Russia

Introduction

Climatic changes are one of the most urgent among modern ecological problems. Climate warming strongly affects the high latitudes of the Northern Hemisphere causing shrinking of the ice cover in the Arctic Ocean (Barber & Massom, 2007), enhancing the influence of Atlantic waters on the arctic regions (Polyakov et al., 2005), and increasing freshwater discharge (Berezovskaya et al., 2005). About 50% of the Arctic Ocean area is occupied by the shallow continental shelf, which plays an important role in the transformation of water masses (Aagaard et al., 1981), biogeochemical processes and carbon cycling in the Arctic (Stein & Macdonald, 2004). The forecasted climate-induced changes in atmospheric processes, temperature-salinity characteristics of water masses, water stratification, sedimentation processes, and ice-free period duration will cause changes in light regime and phytoplankton bloom period, as well as the amount and distribution of nutrients. This will directly affect biochemical processes and their rate, planktic and benthic assemblages and the higher components of food webs, as well as the productivity of the arctic marine ecosytems.

The main goals of the biological investigations during the summer expeditions of 2007 and 2008 were 1. monitoring the Laptev Sea shelf ecosystems to gain additional information on the structure and functioning of arctic ecosystems during the ice-free period in relation to various environmental parameters and 2. analysis of food webs and carbon flux in shelf ecosystems and assessment of the role of autotrophic and heterotrophic elements of food webs in the carbon cycle. The main research tasks were:

- investigation of the taxonomic composition, total abundance and biomass of phytoplankton and its distribution in the Laptev and Kara seas in relation to diverse abiotic factors and specific conditions of certain years;
- obtaining the data on vertical and lateral distribution of chlorophyll *a*, which is the main indicator of primary productivity in the Laptev Sea, and its daily and seasonal dynamics;
- investigation of the taxonomic composition, spatial and temporal distribution of zooplankton, seasonal dynamics of its total abundance and biomass, as well as variability of the species composition and relative abundance of certain species depending on hydrological and hydrochemical characteristics;
- obtaining new data on the distribution of benthic species, total abundance, biomass, and structure of benthic assemblages in the shelf zone, especially in the region where the polynya is located in winter;
- collecting the data on the composition and abundance of ichthyofauna, birds and mammals as the highest components of food webs.

Material and methods

During the TRANSDRIFT XII expedition biological sampling was performed at 65 stations (Fig. 47). At every station net zooplankton samples were taken, in total these were 165 samples. Water samples for chlorophyll *a* measurements were obtained at 56 stations (in total 394 samples). The number of net phytoplankton samples is 58. Samples for macrobenthos investigation were collected at 15 stations. Sampling for meiobenthos was carried out at 13 stations, and the total number of samples is 48.

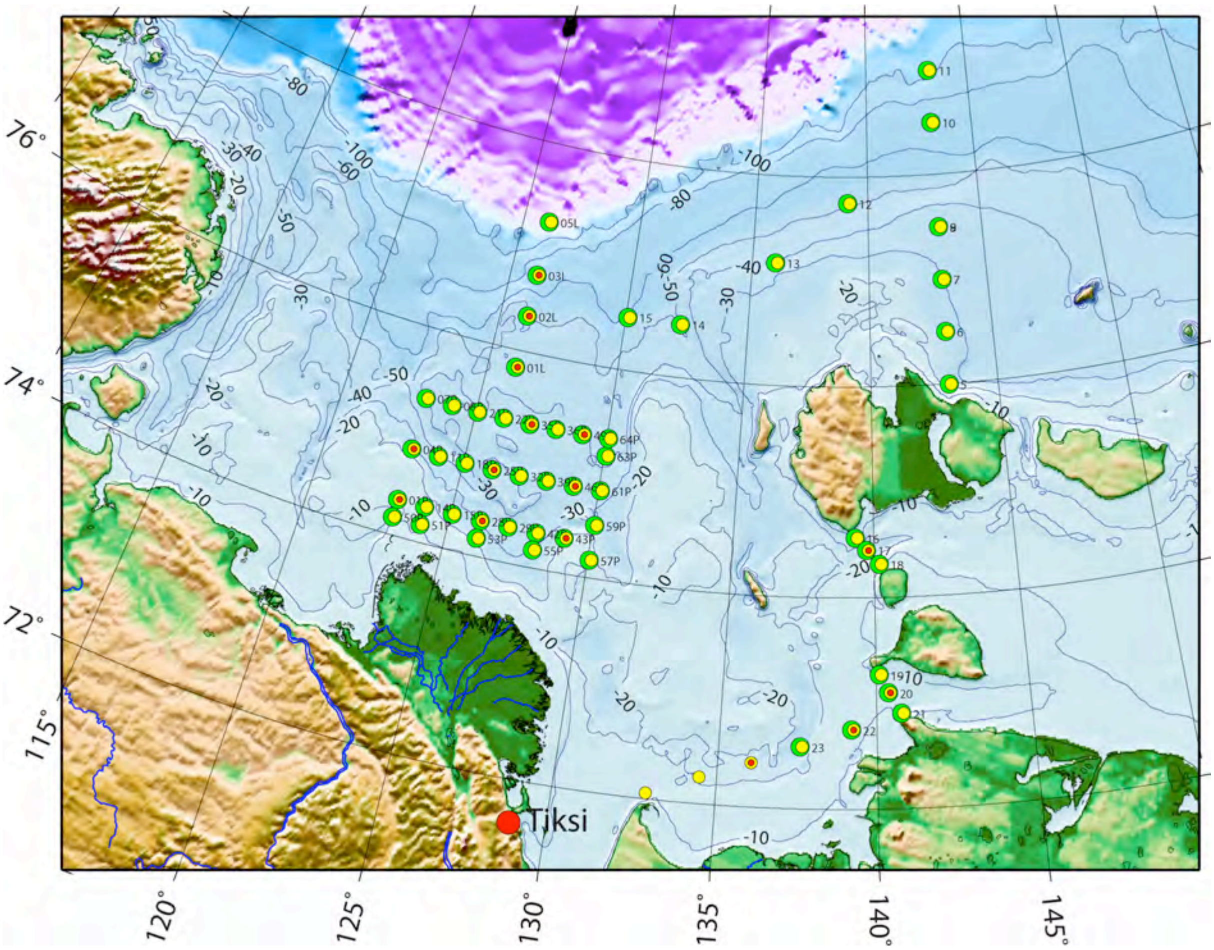


Fig. 47: Stations where macro/meiobenthos (red), zoo/phytoplankton (yellow) and chlorophyll *a* (green) samples were taken during TRANSDRIFT XII.

In 2008 during the TRANSDRIFT XIV expedition biological sampling was carried out at 47 stations in the Laptev Sea (Fig. 48). In total 315 water samples were collected for chlorophyll *a* measurements. Additionally, at every station data on chlorophyll *a* pigment were recorded with 4 measurements per second by the fluorescence sensor WetLabs. In total, 47 samples for macrobenthic investigations were collected. 85 zooplankton samples and 46 phytoplankton samples were collected. The total number of samples for meiobenthos study is 13.

Chlorophyll *a* samples (0.5 or 1 liter) were taken at selected water depths (2 m, 5 m, 10 m, 15 m, 20 m, etc.). The samples were filtered onboard on glass GFF filters with a pore diameter of 0.7 µm and frozen at -20ºC for preservation and transport. Measurements were carried out at the OSL (AARI) using the fluorimeter TD-7000.

Phyto and zooplankton were sampled with hand nets with an opening diameter of 50 cm and meshsizes of 20 and 200 µm. At every station two zooplankton samples were taken: one total from seafloor to surface, and another one from the upper water layer above the pycnocline. In 2007, a closing net was also used. The daily station IP07-2-004L-7 was carried out, where every three hours every 10 m were sampled continuously one after the other. Phytoplankton samples were taken only from the upper 10 m. Phyto and zooplankton samples were fixed with 4% neutral formalin.

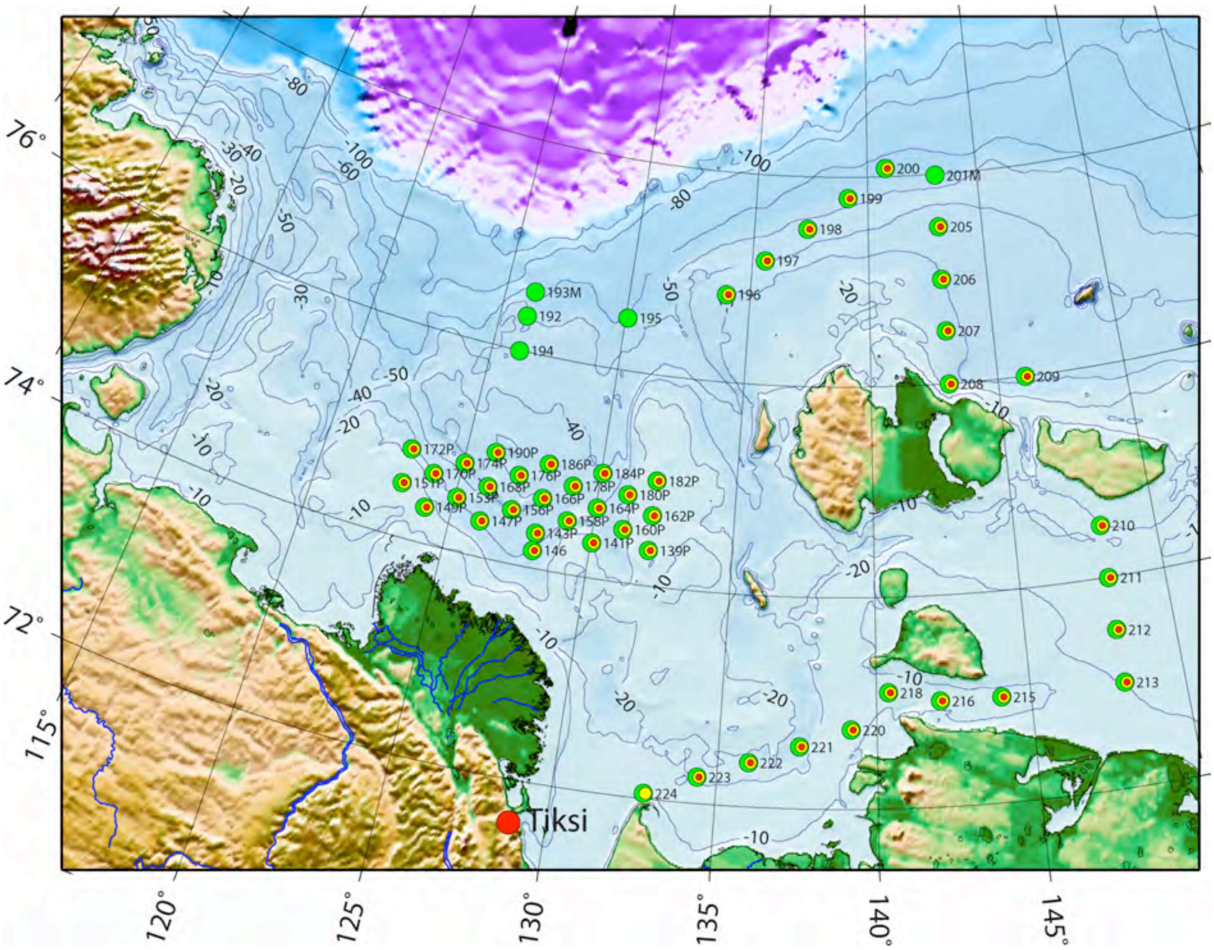


Fig. 48: Stations where macro/meiobenthos (red), zoo/phytoplankton (yellow) and chlorophyll *a* (green) samples were taken during TRANSDRIFT XIV.

Samples for zoobenthos investigations were taken with a modified Van Veen grab (0.08 m^2). Samples for macrozoobenthos studies were washed over a 0.5 mm meshsize sieve and fixed with 70% ethanol. Samples for meiozoobenthos investigations were taken in the upper 1 cm thick sediment layer collected over an area of 0.01 m^2. They were stained with a 96% ethanol solution of Rose Bengal.

<u>Preliminary results</u>

Phytoplankton

In the net phytoplankton samples from the surface water layer (8-10 m) of the Laptev and Kara seas collected in the second half of August, algae were represented by 32 species; of these Bacillariophyta comprised 23 species, Dinophyta 5 species, and Chlorophyta 4 species. The taxonomic diversity of algae was higher in the Kara Sea compared to the Laptev Sea. Diophytes constituted the major part of the phytoplankton over the whole studied territory besides the region affected by the Ob' River in the Kara Sea. This evidences that during the second half of August phytoplankton was at the latest stages of successional development.

In the Laptev Sea, *Cylindrotheca closterium* and *Protoperidinium pallidum* predominate at almost all stations, both in abundance and biomass. In the regions affected by Lena River discharge also the freshwater algae *Asterionella formosa* is abundant. In the Kara Sea close to Severnaya Zemlya, *P. pallidum* is dominant in biomass while *P. pallidum* and *C. closterium* are most abundant. In the shallow region close to the estuaries of the Ob' and Yenisei the biomass is largely constituted by *Ceratium longipes* and *Dinophysis* sp. Close to the Yenisei River *Chaetoceros concavicornis* is also abundant while *Coscinodiscus oculus-iridis* is abundant close to the Ob' River and in the westernmost station along the 74°N transect.

The phytoplankton associations in the region under study can be grouped into four clusters: phytoplankton of the Laptev Sea and the region between the Laptev and Kara seas close to Severnaya Zemlya coast; and three associations in the Kara Sea: in the regions affected by the Yenisei River, by the Ob' River, and the westernmost station along the 74°N transect. Phytoplankton in the Laptev Sea is less diverse than in the Kara Sea. At the boundary between the two seas near Severnaya Zemlya, phytoplankton resembles that of the Laptev Sea rather than that of the Ob'-Yenisei shallow regions.

The phytoplankton of the Laptev Sea is characterized by relatively low total biomass (averaging 2.6 mg*day/m^3) and low relative abundance of autotrophic organisms (5-42%). Phytoplankton at the boundary between the Kara and Laptev seas near Severnaya Zemlya coast has an average total biomass of 4.3 mg*day/m^3 and is distinguished by the predominance of heterotrophic dinoflagellates and a very low percentage of autotrophic algae (2-4% of the total biomass). Phytoplankton of the Kara Sea has an average biomass of 13.5 mg*day/m^3. It is taxonomically less diverse and has a higher biomass of autotrophic species (average 78%).

The phytoplankton in the Laptev Sea is generally dominated by smaller algae than in the Kara Sea. A high abundance of big-cellular algae in the region affected by the Ob' and Yenisei rivers might be explained by the more intensive mixing of the water column here than in the Lena River affected region of the Laptev Sea.

Chlorophyll a

Lateral distribution of chlorophyll *a* and oxygen on the Laptev Sea shelf during summer 2007 is shown in Figure 49.

Oxygen distribution is closely related to the distribution of chlorophyll *a* since it is usually dependent on the photosynthetic activity of phytoplankton in any specific region. In summer 2007, two regions with enhanced concentrations of chlorophyll *a* and oxygen are distinguished: one on the southeastern shelf and in the straits between the New Siberian Islands, and another one along the 125°E transect between 76° and 78°N. In the former region the high concentrations of chlorophyll *a* and oxygen are clearly related to river runoff influence. The distribution of temperature and salinity in the surface water layer indicates that the river water plume was restricted to the southeastern region and did not considerably affect the inner shelf. The high chlorophyll *a* concentration in the central Laptev Sea (Fig. 49) is most likely due to the fast ice edge position. Melting of the fast ice produced a patch of the highest chlorophyll *a* concentration at the depth of 15-25 m.

The daily dynamics of chlorophyll *a* concentration in the central region show an interesting pattern. Sensor measurements and laboratory treatment of filters revealed that the chlorophyll *a* concentration at the depth of 20-30 m increases four and more times during one day (Fig. 50). At the same time, the pycnocline position at the depth of 18-20 m did not change. At the beginning of our observations the chlorophyll *a* concentration in this layer did not exceed 2 mg/m^3. During the subsequent 12 hours the concentration of chlorophyll *a* in the pycnocline layer increased by two times. During the next 12 hours the chlorophyll *a* concentration in the layer 20-25 m further doubled and reached the maximum value of 8 mg/m^3 at the depth of 25 m. The daily variability of the oxygen concentration in the layer 15-25 m demonstrates the same pattern (Fig. 50).

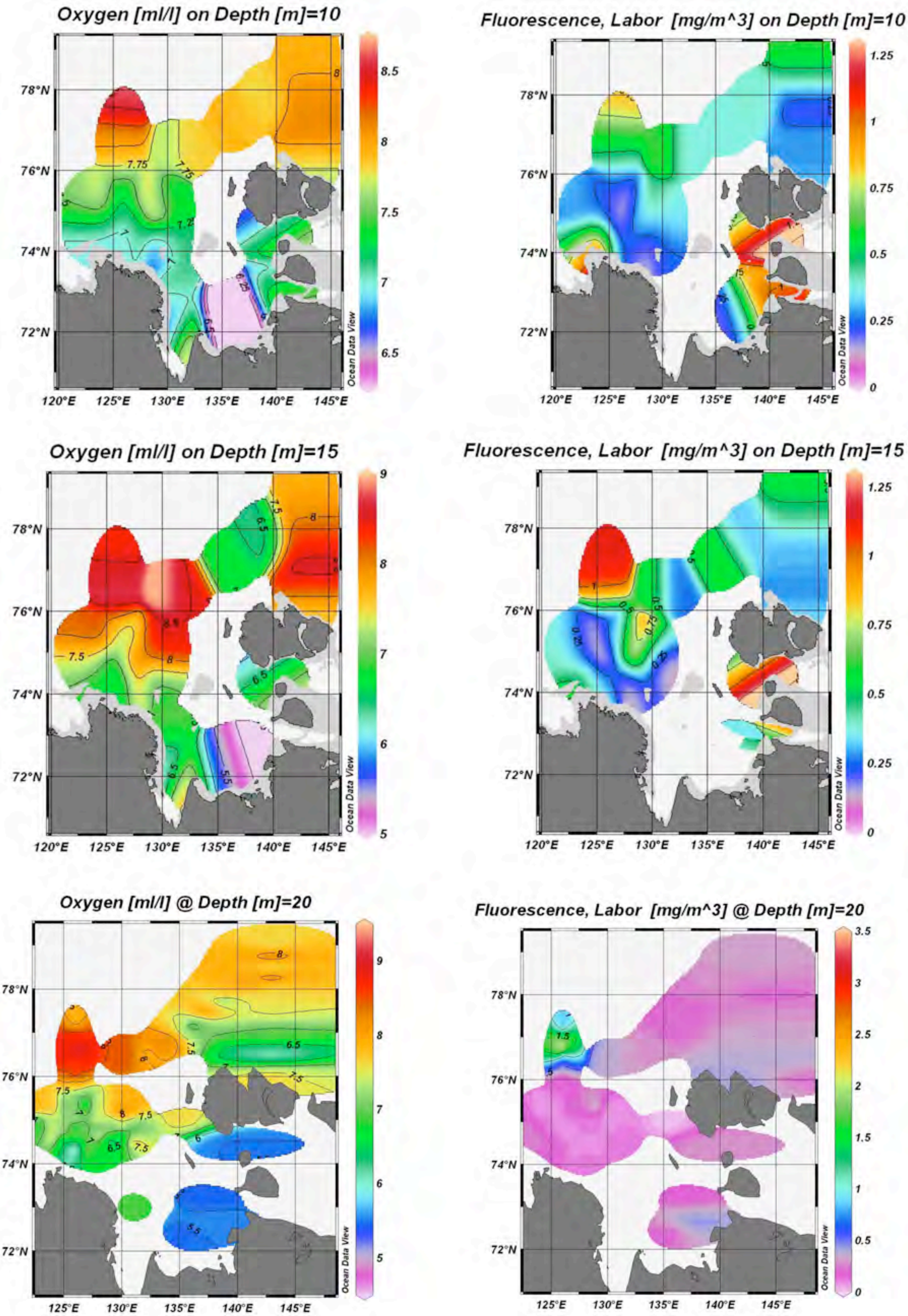


Fig. 49: Oxygen and fluorescence distributions at different depths during TRANSDRIFT XII.

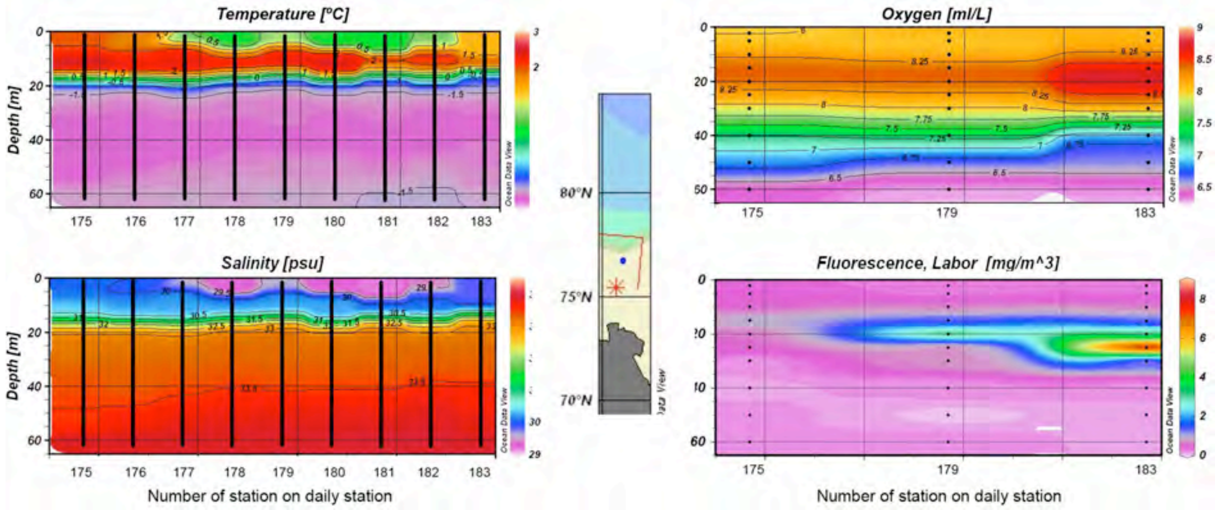


Fig. 50: Daily distribution of temperature, salinity, oxygen, and fluorescence in the central Laptev Sea shelf (76°43'N, 125°54'E).

In summer 2008 temperature-salinity distribution suggests there was another type of river run-off spreading, when part of the river water plume occupied the inner Laptev Sea shelf. The lateral and vertical distributions of chlorophyll *a* and oxygen in the three upper standard layers are shown in Figure 51. Similar to 2007, the highest pigment concentrations were observed in the southeastern and central parts of the shelf. However, the vertical distribution of chlorophyll *a* with the highest values recorded in the surface water layer (Fig. 51) suggests that high concentrations of pigment in both regions are related to the influence of riverine waters.

During a 24 hour long time series carried out in the northern Laptev Sea in 2008 the sensor data and laboratory measurements of filters revealed that the chlorophyll *a* concentration at the depth of 20-30 m increases by a factor of four during one day (Fig. 52). At the start of the observations the chlorophyll *a* concentration between 15-25 m was less than 2 mg/m^3.

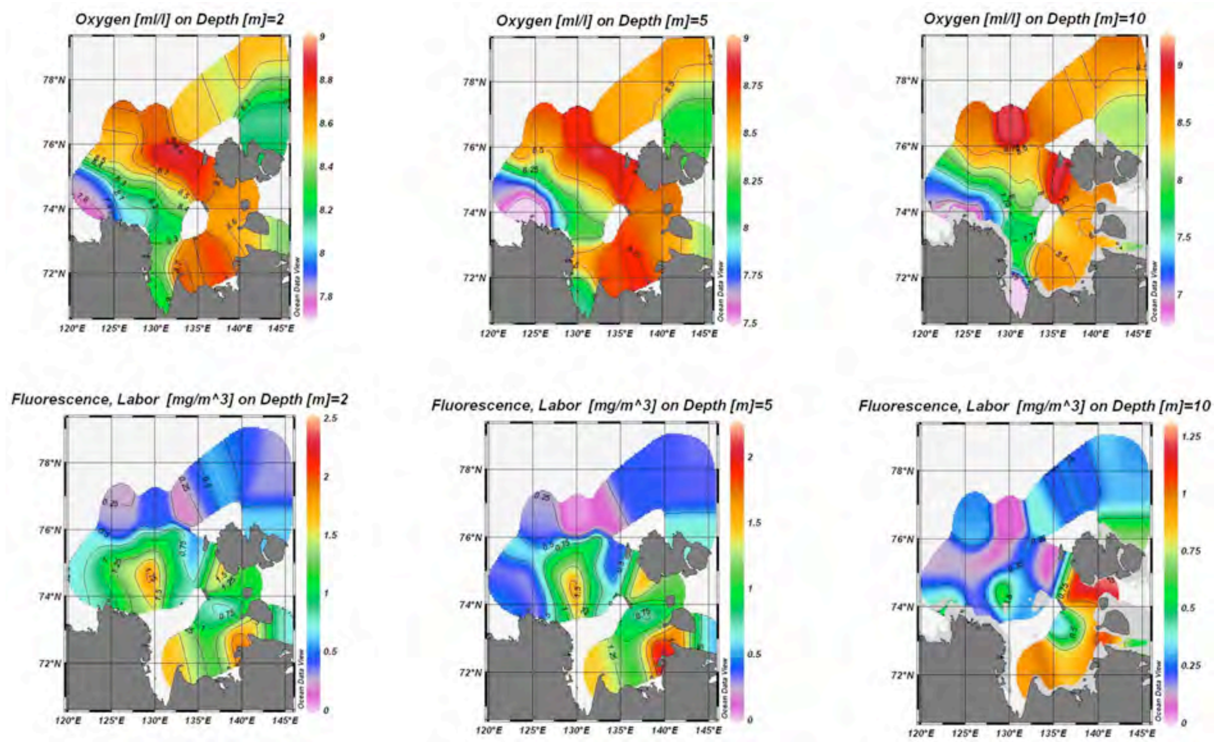


Fig. 51: Distribution of oxygen and fluorescence at 2 m, 5 m, and 10 m water layers in the central Laptev Sea shelf during TRANSDRIFT XIV.

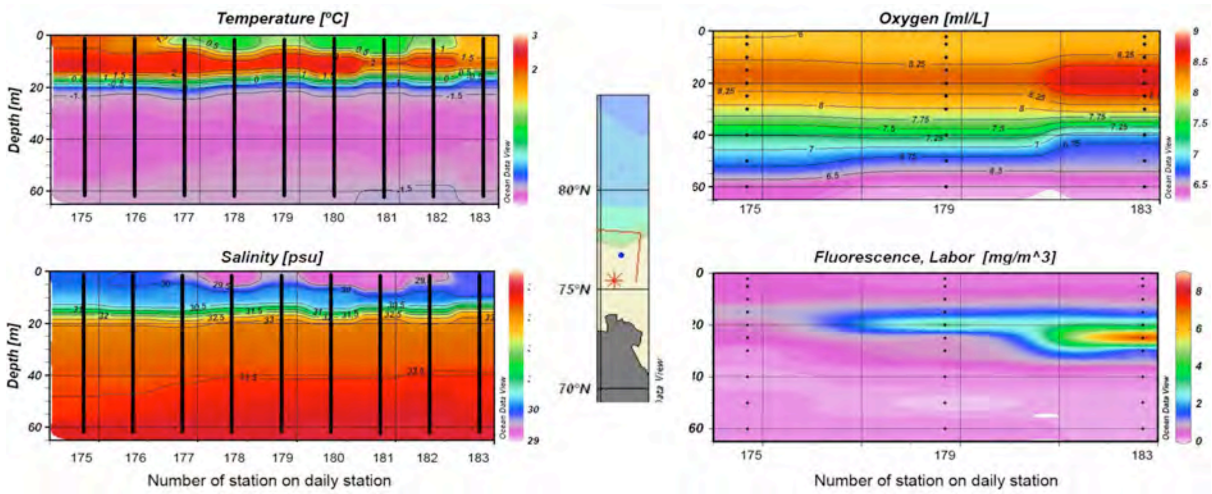


Fig. 52: Time series (24h) of temperature, salinity, oxygen, and chlorophyll concentration (fluorescence, Labor: chlorophyll *a* fluorescence measured on glasfiber filters in the laboratory) in the central Laptev Sea shelf at 76°43'N, 125°54'E.

During the subsequent 12 hours the chlorophyll *a* concentration in the pycnocline layer increased by two times. During the next 12 hours the concentration in the layer 20-25 m further doubled and reached a maximum value of 8 mg/m^3 at the depth of 25 m. The oxygen concentration in the layer 15-25 m also increased. This proves that, as in other continental shelf seas, the horizontal distribution of phytoplankton is patchy. The intensity, morphology, and scale dependence of the plankton spatial pattern are strongly regulated by and spatially correlated with physical oceanographic processes (turbulent advection, upwelling, convergence, and vertical mixing) and the interaction of these processes with bathymetry. The patchiness of the chlorophyll *a* distribution and the fact that the maximum chlorophyll concentration is located at 20 m water depth, which makes the phytoplankton "invisible" for remote sensing methods, underlines the necessity of field studies with high spatial resolution.

Zooplankton

The main component of pelagic fauna in the Laptev Sea shelf is small-size Copepoda. According to long-term observations, the transitional brackish-marine-neritic complex with the dominant assemblage *Oithona similis – Pseudocalanus major – Drepanopus bungei* is common for the central Laptev Sea shelf. In the eastern part of the shelf *D. bungei, P. major* and *Acartia longiremis* are the most abundant species (Abramova & Tuschling, 2005).

During the last 20 years the average relative abundances of the marine euryhaline species *O. similis* in the central and eastern parts of the Laptev Sea shelf varied, depending on hydrological conditions, from 4.0 to 12.7% of the total zooplankton abundance, and that of *D. bungei* from 7.2 to 10.4%. *O. similis* is the dominant species in the pelagic community on the Laptev Sea continental slope (Kosobokova et al., 1998).

The preliminary analysis of materials collected during the expeditions TRANSDRIFT XII and also TRANSDRIFT XIII / POLYNYA-2008 (April-May 2008) gives evidence for certain changes in species composition, distribution and relative abundance of zooplankton species on the Laptev Sea shelf, especially in the polynya region. An abundance increase of euryhaline marine species, primarily *O. similis* and *Microcalanus pigmaeus,* was recorded in the polynya region in summer 2007 (Fig. 53). On the other hand, during this year only rare single specimens of *D. bungei,* another common copepoda species for the central and eastern Laptev Sea and polynya region, were found.

The expansion of the euryhaline marine fauna onto the Laptev Sea shelf could be caused by a wind-induced decrease in freshwater influence and an increase in the influence of waters from the continental slope on the entire Laptev Sea area.

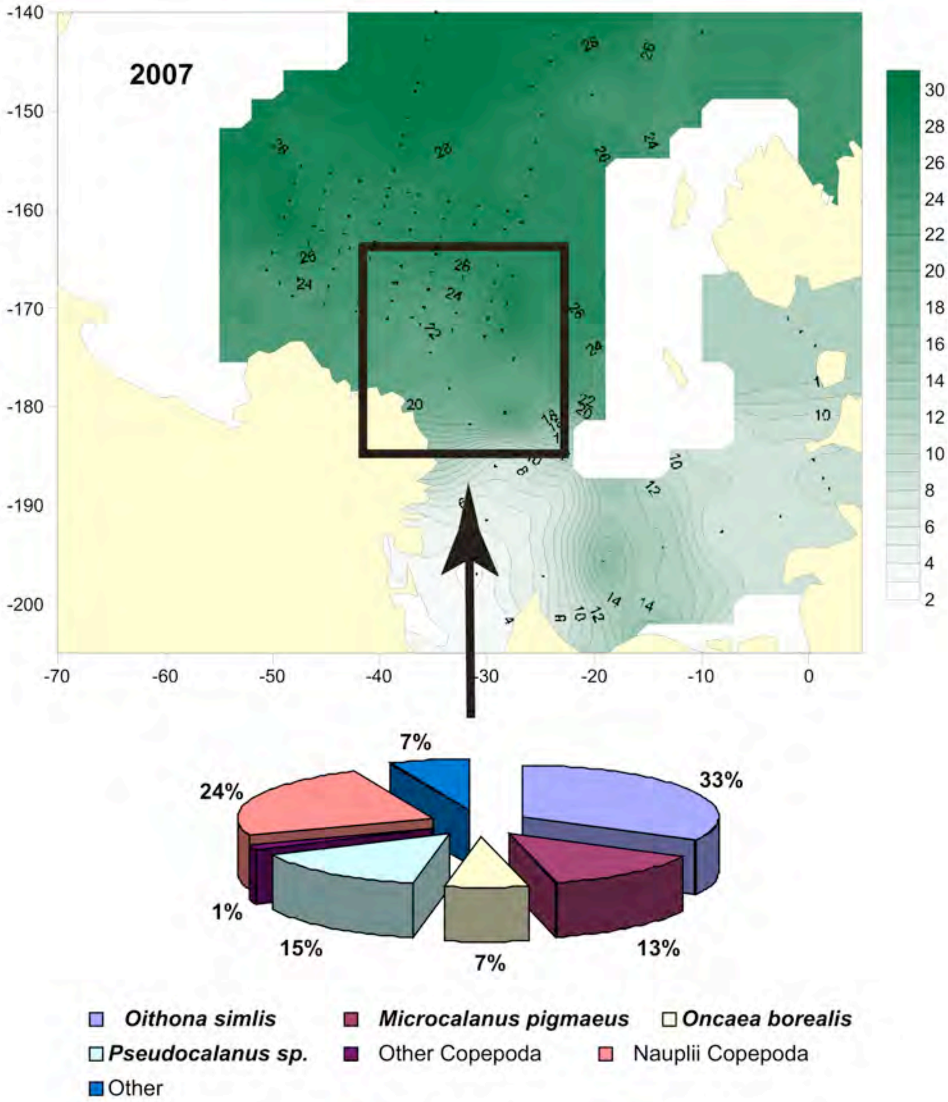


Fig. 53: Salinity distribution and average relative abundance of zooplankton species and groups in the polynya region in summer 2007.

After processing some zooplankton samples collected in summer 2008 in the polynya region, it was revealed that the relative abundance of brackish-water species, such as *Pseudocalanus major* and *D. bungei,* increased. This observation is in good accordance with the hydrological situation of the summer of 2008 when salinity in the region under study was lower than in the previous summer. A detailed analysis of the species composition and distribution of different ecological groups on the Laptev Sea shelf will be carried out after processing all samples.

Preliminary conclusions

Freshwater runoff and its seasonal variability, causing considerable seasonal and interannual changes in the distribution of temperature and salinity, create extremely unstable conditions for the existence of different components of the ecosystems. This especially concerns the pelagic flora and fauna of the Arctic shelf seas. The data obtained during the summer seasons of 2007 and 2008 clearly show the influence of the hydrological situation on the structure and functioning of pelagic communities on the Laptev Sea shelf.

II.4 TRANSDRIFT XVI

The eastern continental shelf of the Laptev Sea is controlled by Siberian river discharge, ice formation and melting, brine rejection in coastal polynyas, and exchange with the Arctic Ocean and adjoining seas. As a main source of freshwater to the Arctic Ocean, the Siberian shelves are also critically important for feeding the halocline layer that buffers the cold, fresh surface layer from the warmer, saltier Atlantic water beneath (Aagaard et al., 1981; Rudels et al., 1996). During summer, the Laptev Sea shelf is generally believed to be sensitive to changes in atmospheric wind forcing (e.g., Dmitrenko et al., 2008a; Abrahamsen et al., 2009). Cyclonic atmospheric circulation in the Laptev Sea region – characterized by a region with low sea level preasure (SLP) northeast of the Lena Delta – leads to an eastward diversion of Lena River water and a negative salinity anomaly east of the Lena Delta. Anticyclonic vorticity (i.e., higher SLP east of the Lena Delta region) resulted in negative salinity anomalies north of the Lena Delta, associated with northward transport of freshwater and a corresponding salinity increase east of the delta. The distribution of river discharge inferred from tracer data also shows cross-shelf offshore transport of river water from the Laptev Sea during the ‘‘anticyclonic’’ summers. Besides the divergence of freshwater also the initial temperature and salinity signatures of the inflow of water masses from the Arctic Basin play a significant role in determining the hydrography of the eastern Laptev Sea.

During winter, the Laptev Sea continental shelf is also known for an active water mass transformation, due to seasonal sea-ice formation (Dmitrenko et al., 2008b, 2009). Long-term observations by means of seafloor observatories (Fig. 54) show that the wind-driven water

Fig. 54: Seafloor obervatories ANABAR deployed north of the Lena Delta during TRANSDRIFT XIV and recovered in September 2009. Biofouling is significant and the levels of fouling have been increasing for several years.

dynamics under the sea-ice are substantially reduced by the factor of ~4-5 (Dmitrenko et al., 2001). Therefore, we assume that the summer salinity patterns are directly projected to the following winter (Dmitrenko et al., in press). Overall, this implies a very minor role of winter water dynamics in modifying the summer-to-winter riverine water pathways. This hypothesis was tested by long-term field studies (TRANSDRIFT XII, XIV, XVI) and observations (seafloor observatories) during the summer seasons of 2007, 2008 and 2009.

The TRANSDRIFT XVI expedition was carried out aboard RV "Yakov Smirnitsky" in the scope of the Russian-German project „System Sea Laptev." TRANSDRIFT XVI started in Tiksi on August 31, 2009 and was successfully completed on September 19, 2009 when the "Yakov Smirnitsky" entered Tiksi port again. 10 scientists from the AARI, IFM-GEOMAR, State Lena Delta Reserve and St. Petersburg State University (in cooperation with POMOR) took part (see Appendix „Lists of participating institutions and scientists").

The key working area of TRANSDRIFT XIV was a so-called „polygone" north of the Lena Delta (Fig. 54). Here the Laptev Sea polynya is active during winter and the important frontal zone between river water from the south and cold water masses from the north dominates the environmental system during the summer months. During TRANSDRIFT XVI a multidisciplinary working program including physical oceanography, marine chemistry, sedimentology and biology was carried out. The primary objective was to recover the seafloor observatories ANABAR, KHATANGA, and OSL2C in order to study the seasonal variability in temperature, salinity and currents as well as ice conditions and shelf-basin interaction.

43 stations with multidisciplinary investigations were carried out in the Laptev Sea (Fig. 55). Three seafloor observatories, deployed during the TRANSDRIFT XIV expedition in summer 2008, were successfully recovered and four seafloor observatories were deployed.

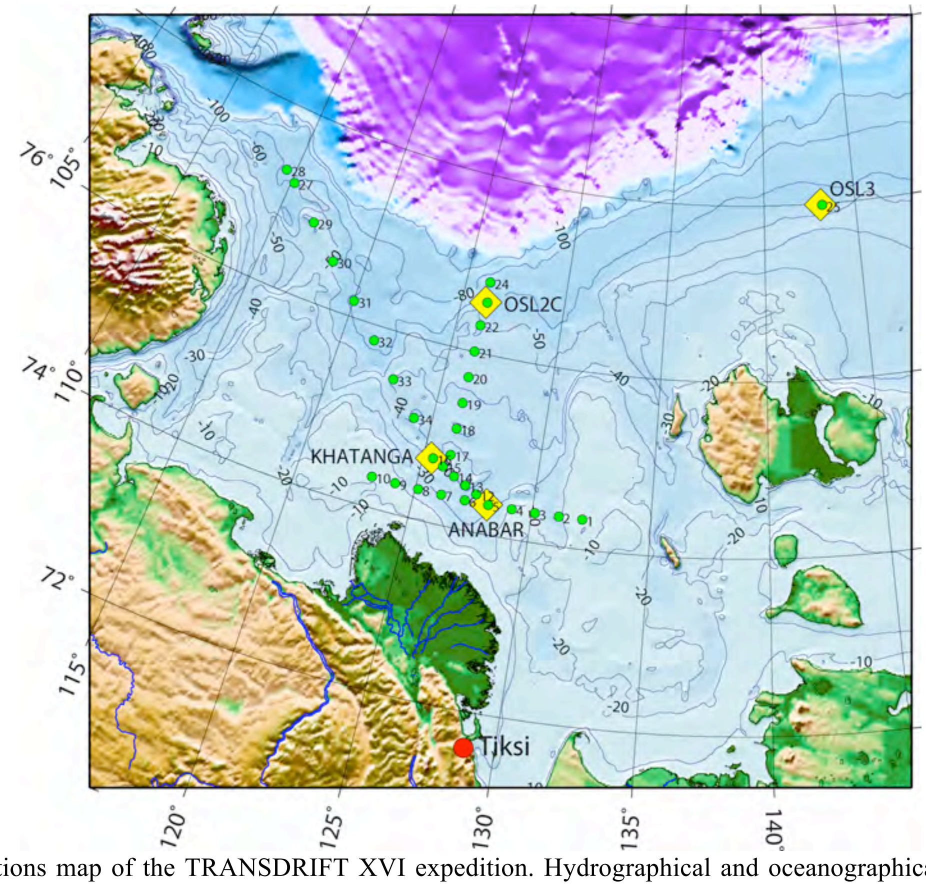


Fig. 55: Stations map of the TRANSDRIFT XVI expedition. Hydrographical and oceanographical stations are marked red. The positions of the seafloor observatories OSL2C, OSL3, KHATANGA and ANABAR are marked yellow. Further details on the stations can be found in the corresponding sections as well as in the complete station list in the appendix.

During TRANSDRIFT XIV the weather conditions were very good (Fig. 56) and the Laptev Sea was ice-free (Fig. 57).

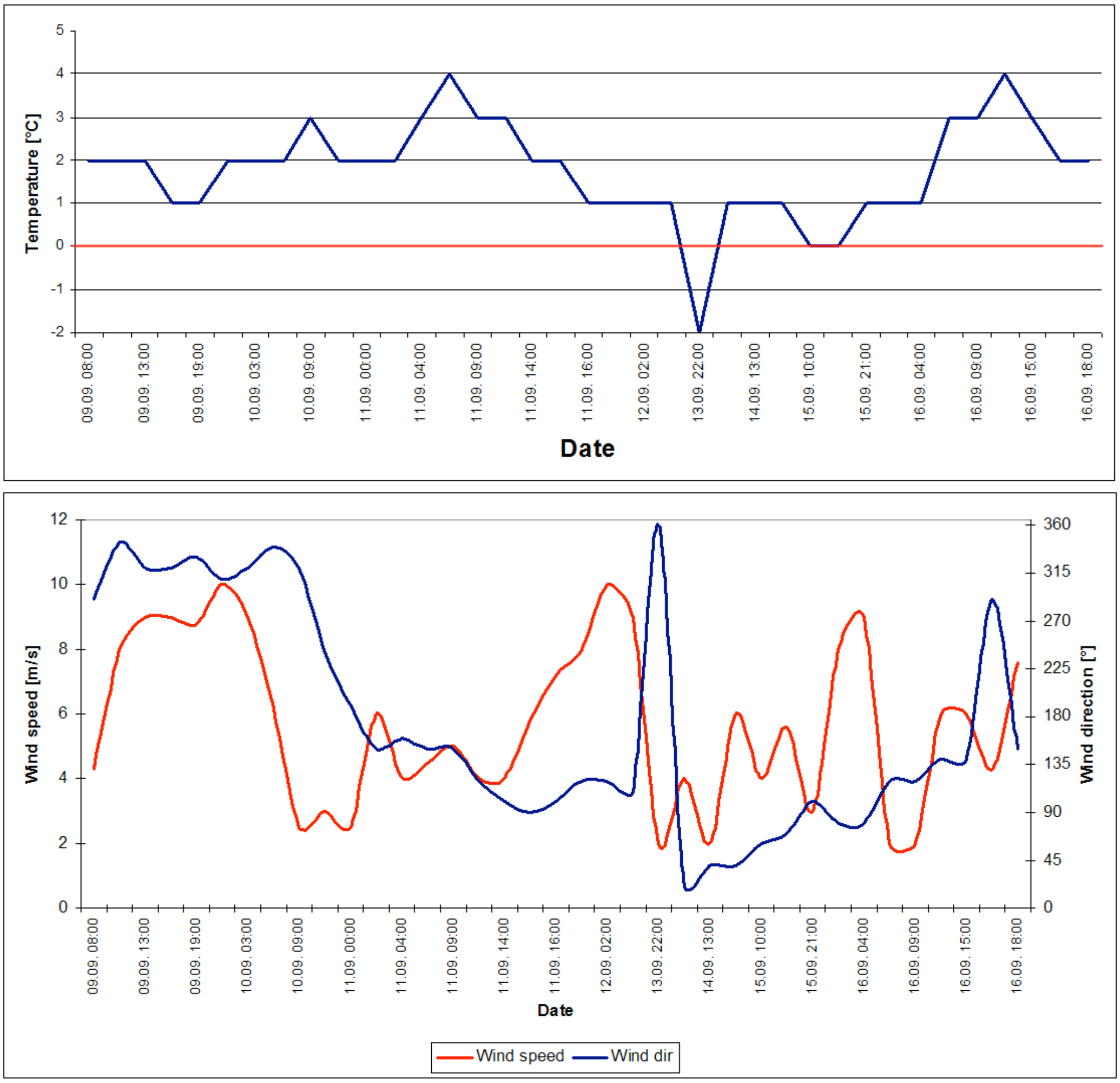


Fig. 56: Temperature (upper panel) and wind conditions (lower panel) during TRANSDRIFT XVI, measured with the ship's meteorological equipment between September 9 and 16, 2009.

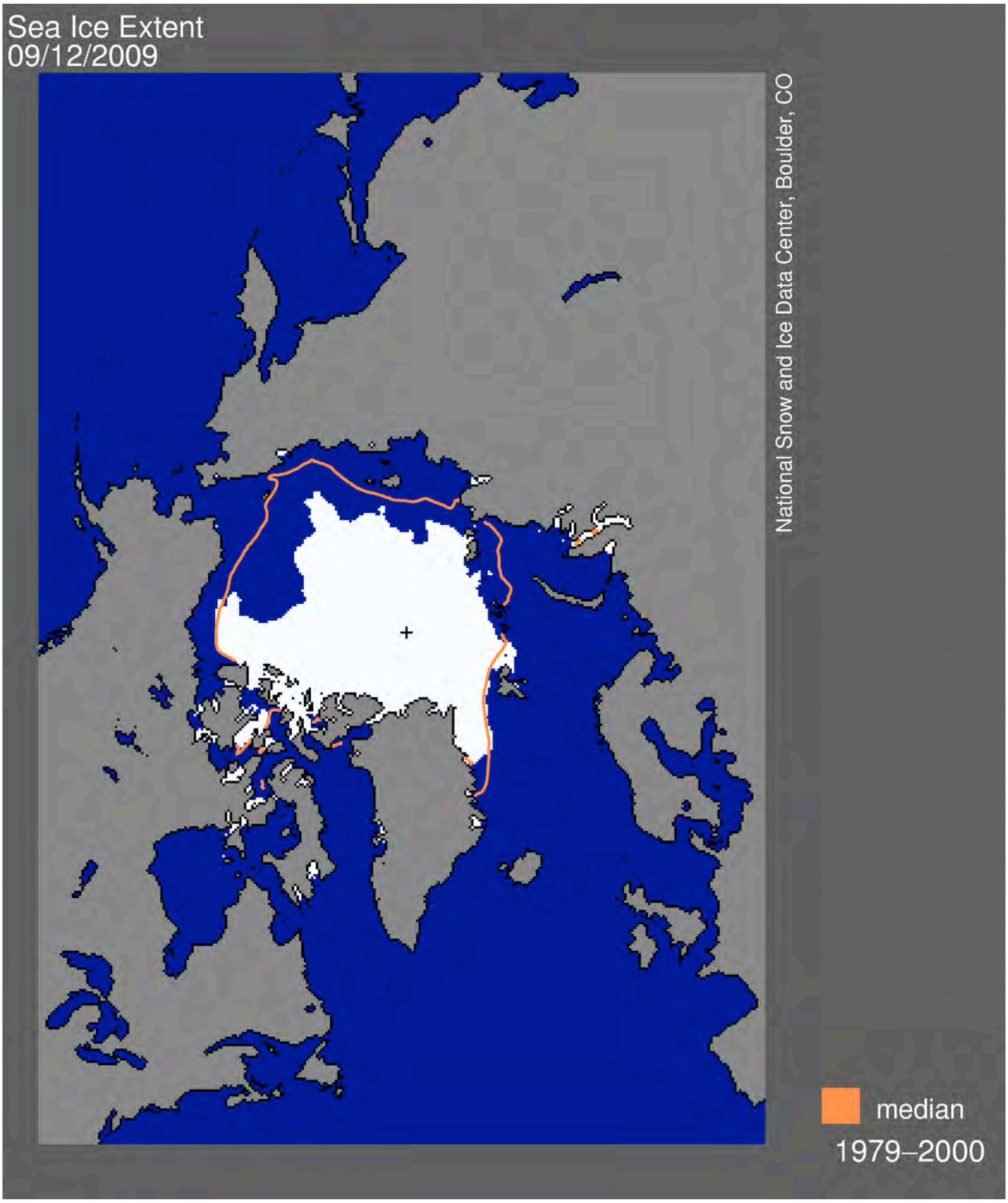


Fig. 57: Arctic sea ice extent on September 12. The orange line shows the 1979 to 2000 median extent for that day. September sea ice extent was the third lowest since the start of satellite records in 1979, and the past five years have seen the five lowest ice extents in the satellite record. Arctic sea ice is now declining at a rate of 11.2 percent per decade, relative to the 1979 to 2000 average.

Physical oceanography

T. Klagge[1], N. Mengis[1]
[1]Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

During TRANSDRIFT XVI an extensive oceanographic survey was carried out at 32 stations in the Laptev Sea (Fig. 58). High resolution CTD profiles were recorded at each station showing the distribition of salinity, temperature, turbidity, chorophyll an oxygen throughout the whole water column. Table 7 shows the important parameters of the used instruments and sensors. The exact positions of each station can be found in the complete sampling list in the Appendix.

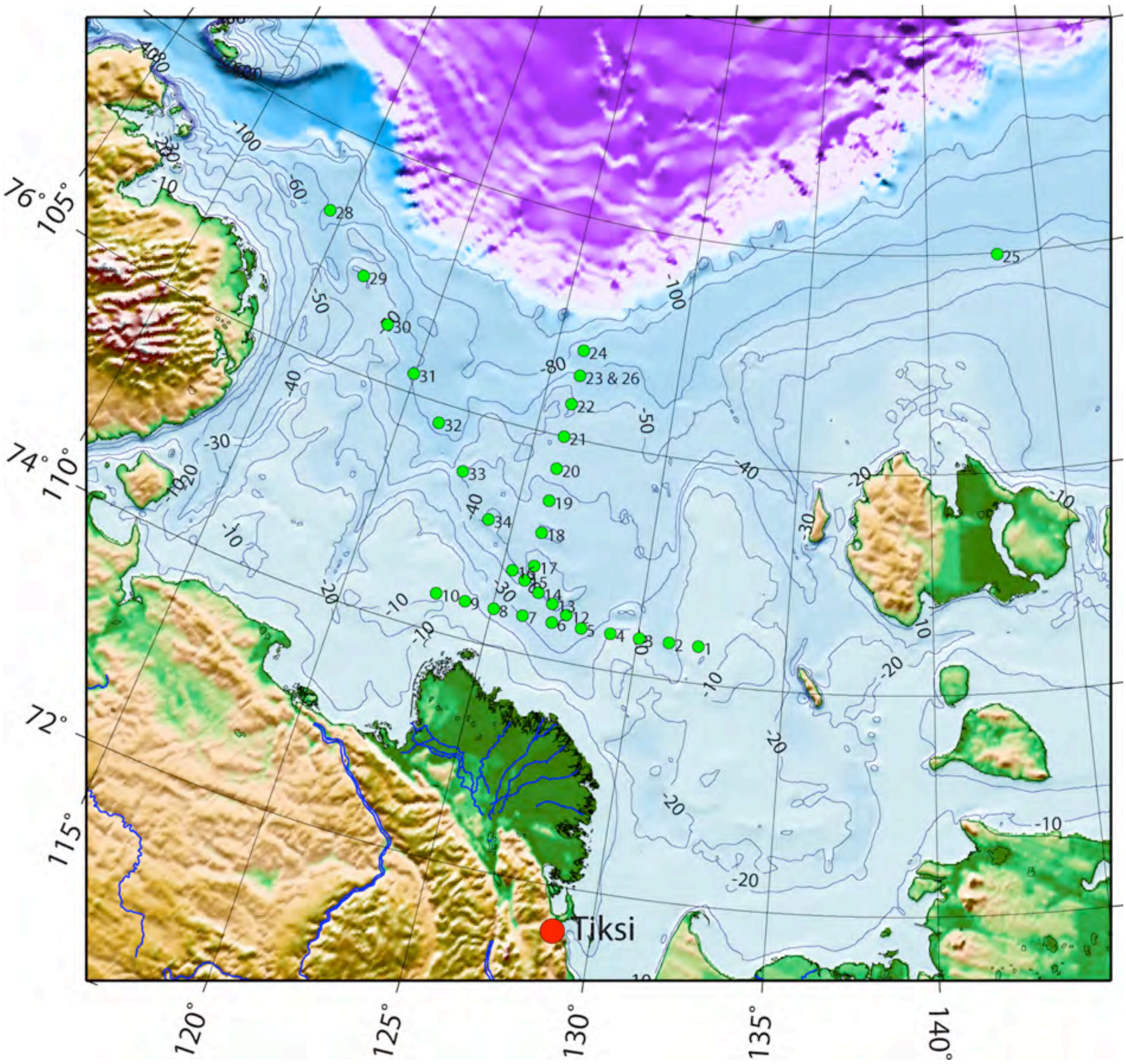


Fig. 58: CTD profiles that were carried out during TRANSDRIFT XVI.

Table 7: Details for all instruments that were mounted on the SBE19+

Instrument	Producer	Sampling rate	Accuracy	Last calibration
Conductivity sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.0005 S/m	February 2009
Temperature sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.005 °C	February 2008, verified February 2009 (no calibration needed)
Pressure sensor of CTD SBE19+	Seabird Electronics, USA	4 Hz	0.1 % of full scale range	February 2008, verified February 2009 (no calibration needed)
Turbidity sensor	Seapoint	4 Hz	< 2% deviation for 0-750 FTU	June 2008
Oxygen sensor SBE43	Seabird Electronics, USA	4 Hz	2 % of saturation	August 2009
Chlorophyll sensor	Wetlabs Wetstar	4 Hz	0.4 mV	July 2007

Methods and equipment

Investigations at oceanographic stations included water probing and sampling with the use of the following equipment: CTD (Conductivity, temperature, depth) probe SBE 19 plus attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module) (Fig. 59). The rosette operates offline, i.e. the operational control and data transfer are maintained without a cable. Maximum operational depth is 6,800 m.

Fig. 59: CTD probe SBE 19+ attached to a programmable rosette SBE 32C with 5-liter plastic water-sampling bottles with a release for the opening of water-sampling bottles at certain depth levels (Auto Fire Module).

The release for automatic opening of water-sampling bottles at certain depth levels, Carousel Auto-Fire Module (AFM), includes microprocessor, semi-conductor memory, RS-232 interface, and batteries. The device records the hydrostatic pressure real-time measurements transferred by the probe and closes the sampling bottles at certain water depth levels. Also, the AFM records the sequence of bottle closures in its own memory: number, time, closure verification, and 5 CTD scans for every closed water-sampling bottle.

AFM power supply is maintained by 9 batteries Duracell MN1300 (LR20) allowing for about 40 hours of work or by nickel-cadmium batteries.

The oceanographic probe SBE 19plus SEACAT Profiler produced by Sea-Bird Electronics, Inc., USA, measures the following characteristics of seawater: temperature, conductivity, and hydrostatic pressure (Fig. 60). The measurement ranges are -5 to 35 °C for temperature, 0 to 9 cm/m for conductivity, and 0 to 600 m for hydrostatic pressure (maximum operational depth). The accuracy is 0.005°C for temperature, 0.0005 cm/m for conductivity, and 0.1% of the total measurement range for the hydrostatic pressure. Stability (monthly) of the temperature sensor is 0.0002 °C, that of the conductivity sensor is 0.0003 cm/m, and of the hydrostatic pressure sensor 0.004 % of the total measurement range. Resolution for temperature measurements is 0.0001 °C, for conductivity measurements 0.00001 cm/m for freshwater, 0.00005 cm/m for seawater, and 0.00007 cm/m for highly saline water, and for hydrostatic pressure measurements 0.002 % of the total measurement range. The frequency of along-transect measurements is 4 scans per second (4 Hz).

The probe is equipped with a fixed memory of 8 Mb recording the measurement results. The interface is RS-232C. Power supply is maintained either by 9 batteries Duracell MN1300 (LR20) allowing for 60 hours of profiling or nickel-metalhydride or nickel-cadmium batteries. Information is downloaded from the fixed memory after the end of measurements with the help of standard cable and software. Remote data downloading is not possible for this probe.

Fig. 60: Oceanographic probe SBE 19plus SEACAT Profiler equipped with sensors for measuring water turbidity, dissolved oxygen concentration and fluorescence.

Metrological characteristics are under control of the operating company.

The probe is equipped with additional sensors produced by Sea-Bird Electronics, Inc., USA, for measuring water turbidity, dissolved oxygen concentration and fluorescence.

The CTD measured during the whole down- as well as upcast of the rosette on each station, while for further processing only the downcast data was processed. This was done to ensure that the SBE19+, despite the even attached pump, has sufficient fresh water for measurements in each depth. Some initial tests showed that especially the oxygen sensor (SBE43) on the SBE19+ was responding too slow to get accurate measurements on upcasts. If necessary the upcast data to all measurements is available in raw format, but we strongly recommend the use of only the downcast data for all sensors.

Seafloor Observatories

T. Klagge, N. Mengis
Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

During the TRANDRIFT XVI expedition in September 2009 four seafloor observatories were deployed for the period of one year on four different locations in our working area (Fig. 61). The aim was to study the seasonal variability in temperature and salinity distribution within the water column, interacting processes in the transition water column/sediment and in the current system, and the transport processes as well as to monitor the ice conditions. Two of these seafloor observatories were deployed in the shelf area (30-45 m water depth) north of the Lena Delta to characterize processes in an onshore/offshore environment, to study changes in the hydrodynamic system and its interaction with the seafloor, and to catch polynya events during winter time. The other two seafloor observatories were deployed more off-shore to study the basin-shelf interaction.

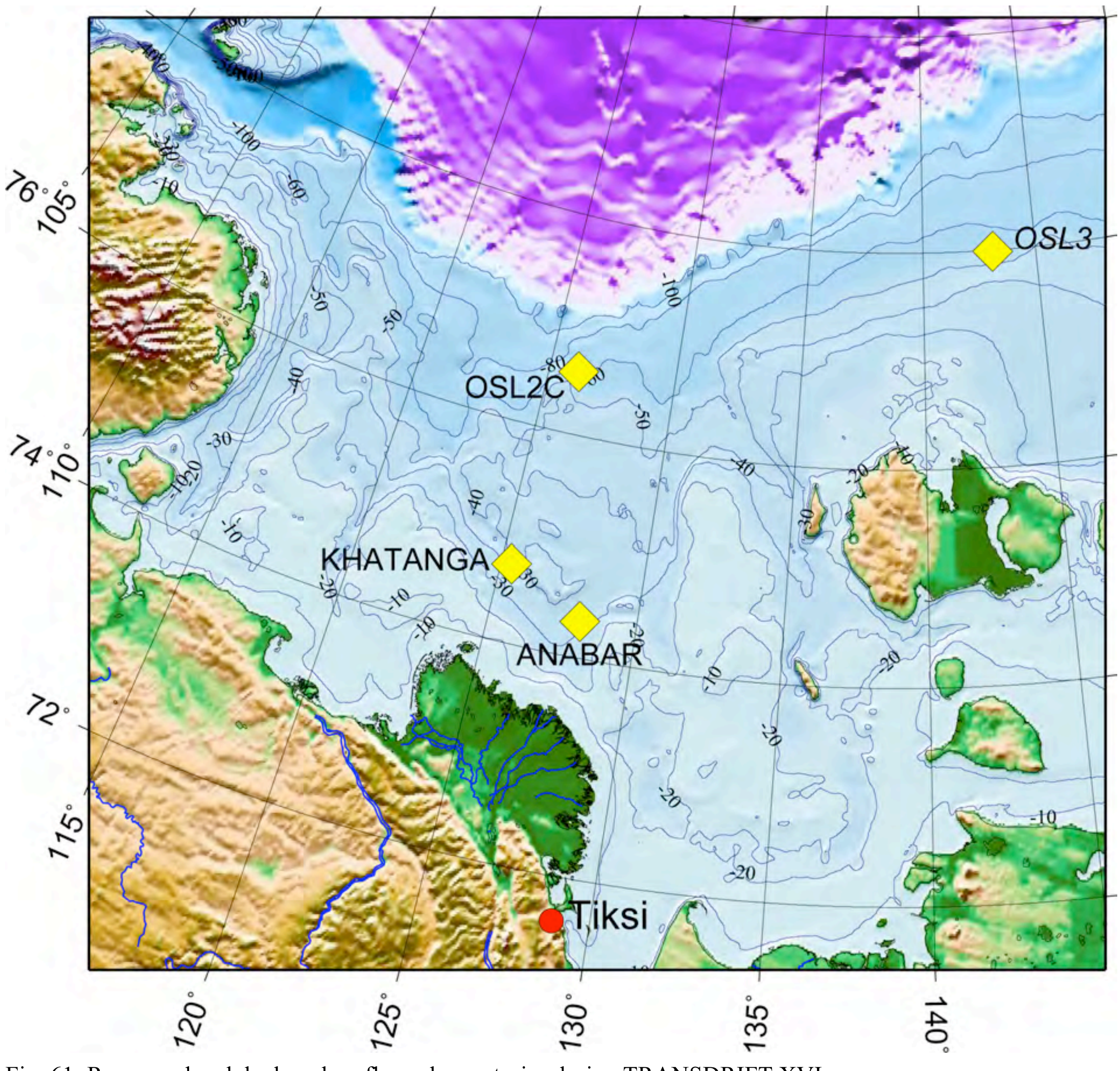


Fig. 61: Recovered and deployed seafloor observatories during TRANSDRIFT XVI.

Three of these seafloor observatories, namely ANABAR, KHATANGA and OSL2C, were successfully recovered during the TRANSDRIFT XVI expedition, and all three were re-deployed at the very same positions they were recovered from. The fourth seafloor observatory, OSL3, was not recovered due to an electronic failure in the IXSEA release. Even dredging to catch this seafloor observatory with hooks was performed for approx. 8 hours but was not successful either. Figure 61 shows all locations of seafloor observatory recovery and deployment.

<u>ANABAR (Fig. 62)</u>

Deployed: 2009-09-16, 17:20 UTC
Position GPS60: 74°19,9176'N, 128°0,162'E; Decimal: N74.33196°, E128.00270°
Depth: 32.8 m
Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9271
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I;
  Memory: 64 Mbyte Flash-memory
  Serial: 9207
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14606
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14605
- CTD Seabird 37 IMP
  Memory: 2 Mbyte Flash-memory
  Serial: 37IMP46569-5388
- SCOUTS System
  Central processing unit (SE) serial: 002
  Popup-Buoy 1 serial: 020
  Popup-Buoy 2 serial: 021
- Release IXSEA OCEANO 2500
  Serial: 004
- Release IXSEA OCEANO 2500
  Serial: 005

Sampling:

- the ADCPs are programmed to take a full sample (direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE37IMP is programmed to take a full sample (pressure, temperature, conductivity) every 15 minutes
- the CTDs from RBR are both programmed to take a full sample (temperature, conductivity, turbidity) every 30 minutes

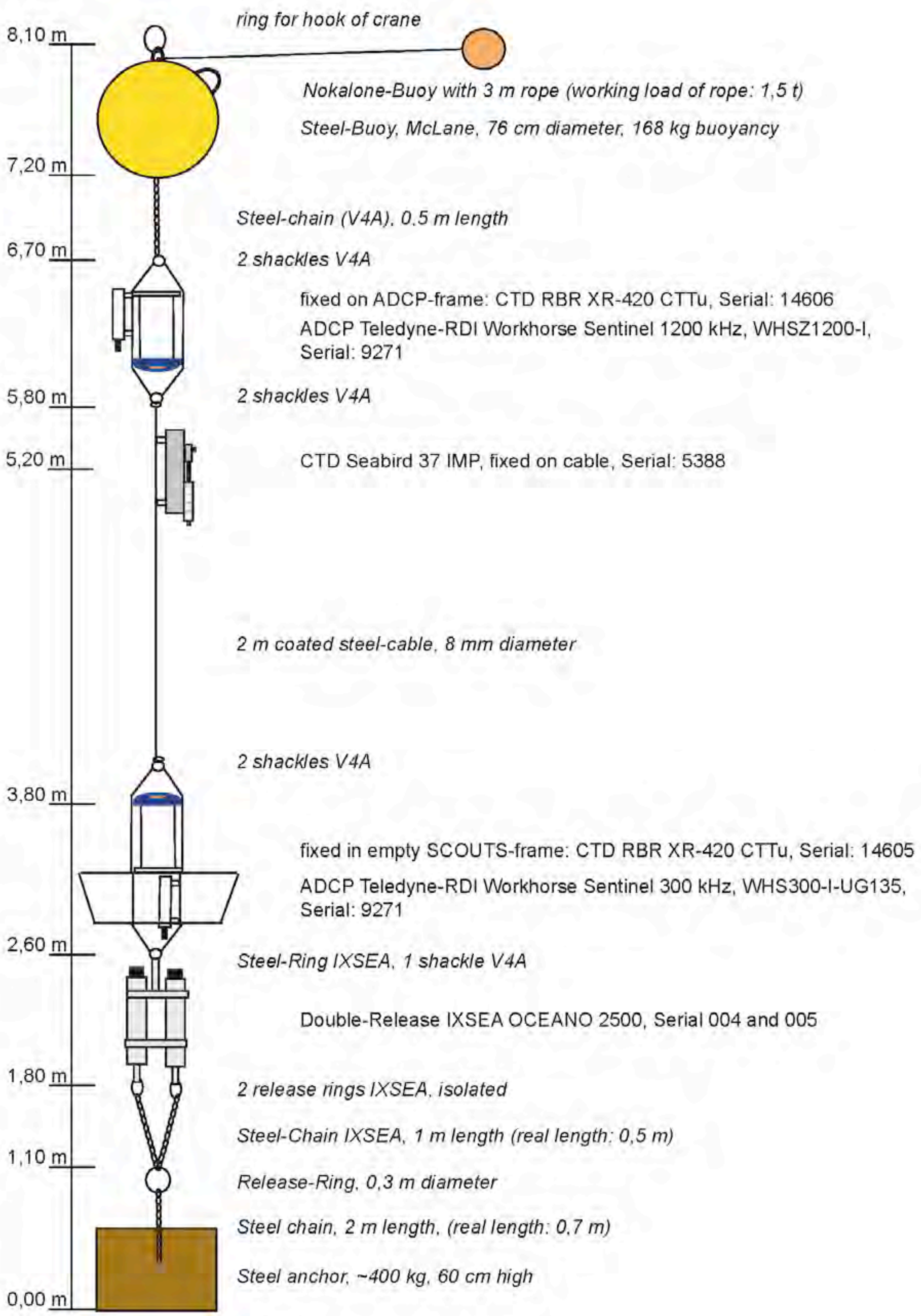


Fig. 62: Design of the seafloor observatory ANABAR, deployed on September 16, 2009.

KHATANGA (Fig. 63)

Deployed: 2009-09-16, 08:40 UTC
Position GPS60:74° 42.942'E, 125° 16.9464'N; Decimal: N74.71570°, E125.28244°
Depth: 45 m

Devices:

- ADCP Teledyne-RDI Workhorse Sentinel 300 kHz WHS300-I-UG135
  Memory: 64 Mbyte Flash-memory
  Serial: 9226
- ADCP Teledyne-RDI Workhorse Sentinel 1200 kHz WHSZ1200-I
  Memory: 64 Mbyte Flash-memory
  Serial: 9208
- CTD RBR XR-420 CTTu
  Memory: 8 Mbyte Flash-memory
  Serial: 14604
- CTD RBR XR-420 CT
  Memory: 8 Mbyte Flash-memory
  Serial: 14607
- CTD Seabird 37 IMP
  Memory: 2 Mbyte Flash-memory
  Serial: 37IMP46569-5387
- Release IXSEA OCEANO 2500
  Serial: 002
- Release IXSEA OCEANO 2500
  Serial: 003

Sampling:

- the ADCPs are programmed to take a full sample (direction and velocity of the currents in the whole water column above the instrument, distance to the surface above the instrument) every 30 minutes
- the CTD SBE37IMP is programmed to take a full sample (pressure, temperature, conductivity) every 15 minutes
- the CTDs from RBR are both programmed to take a full sample every 30 minutes. For the RBR logger with serial #14607 this is temperature and conductivity, while #14607 has an additional turbidity sensor

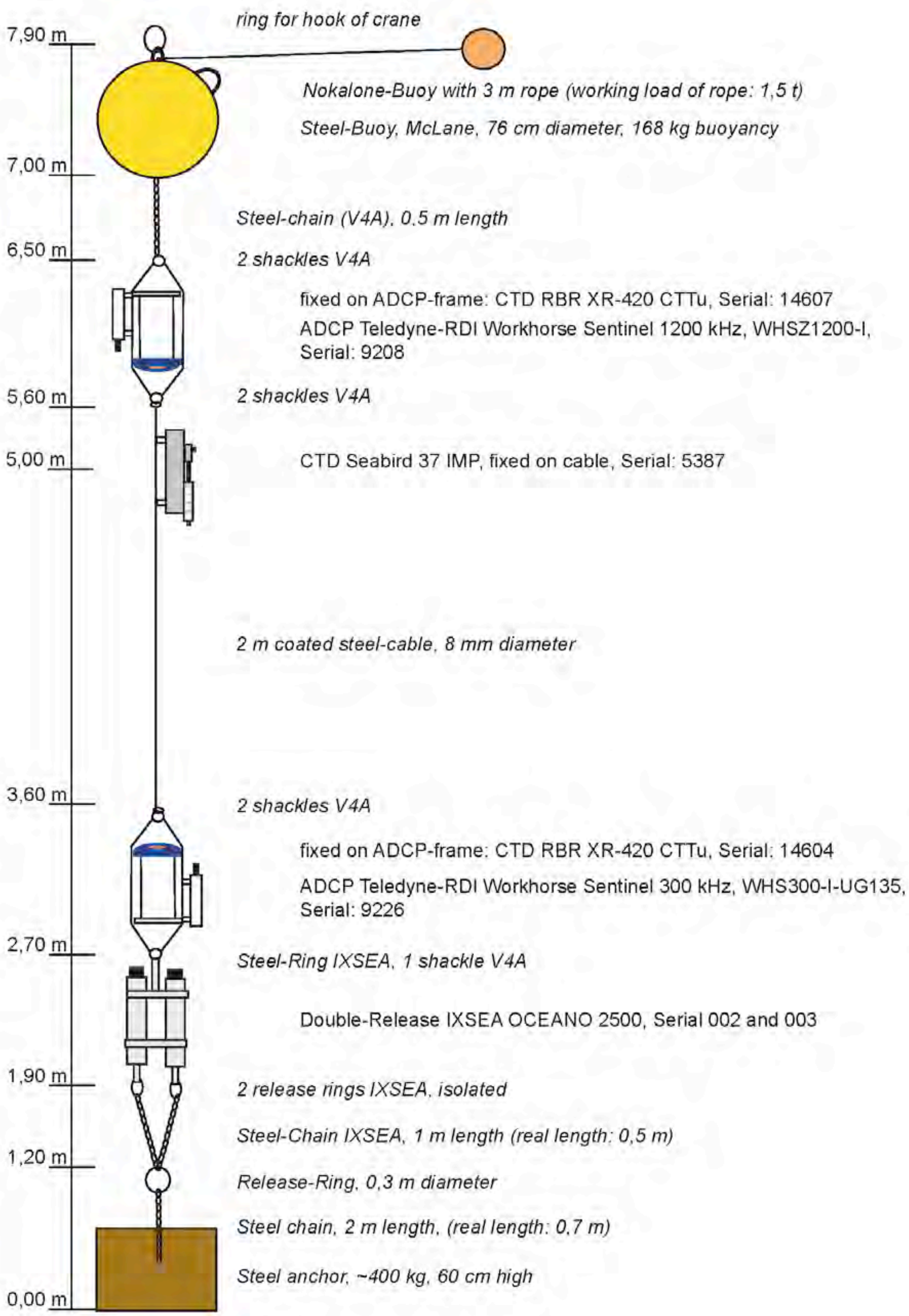


Fig. 63: Design of the seafloor observatory KHATANGA, deployed on September 16, 2009.

OSL2D (Fig. 64)

Deployed: 2009-09-14, 12:30 UTC
Position GPS60: 76°34.1964'N, 126°04.9458'E; Decimal: N76.56994°, E126.08243°
Depth: 57 m

Devices:

- CTD Sea and Sun Technologies CTD48M with additional Turbidity sensor
  Memory: 8 Mbyte Flash-memory
  Serial: 353
- RBR XR-420 Turbidity sensor
  Memory: 8 Mbyte Flash-memory
  Serial: 10019
- CTD Seabird SBE37SMP
  Memory: 8 Mbyte Flash-memory
  Serial: 6724
- CTD Seabird SBE37SMP
  Memory: 8 Mbyte Flash-memory
  Serial: 6725
- Release IXSEA OCEANO RT 861 B1S
  Serial: 490

Sampling:

- both CTD SBE37SMP are programmed to take a full sample (pressure, temperature, conductivity) every 15 minutes
- the RBR-logger is programmed to take a sample (turbidity) every 15 minutes
- the CTD48M is programmed to take a full sample (pressure, temperature, conductivity and turbidity) every 30 minutes

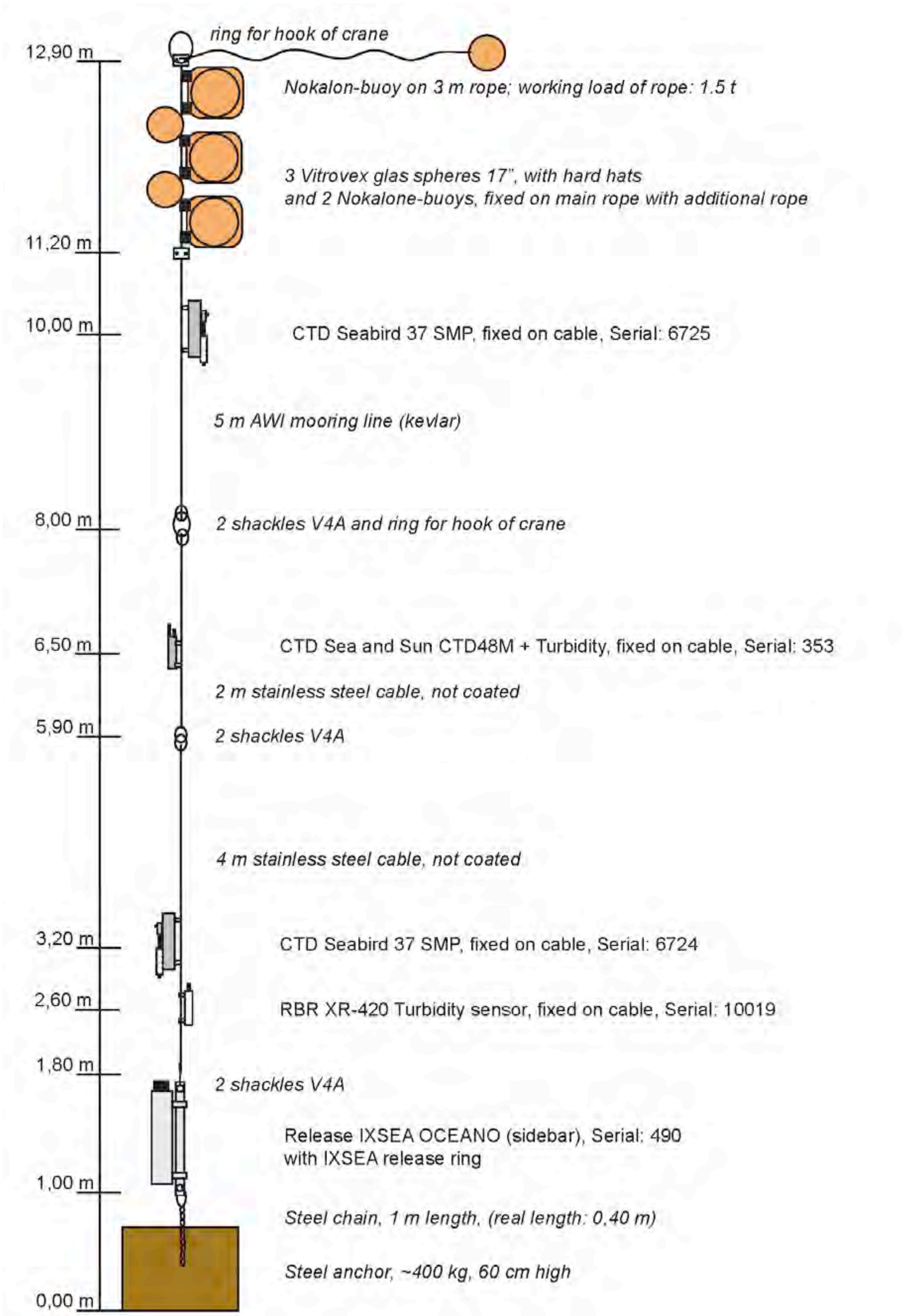


Fig. 64: Design of the seafloor observatory OSL2D, deployed on Septebmer 14, 2009.

Hydrochemical investigations

A. Novikhin[1], E. Dobrotina[1]
[1]Arctic and Antarctic Research Institute, St. Petersburg, Russia

Hydrochemical investigations are important for environmental monitoring. Dissolved oxygen is essential for respiration of organisms. It accumulates in seawater due to photosynthesis and seawater/atmosphere exchange. It is then utilized for respiration and decomposition of organic matter. Nutrients (silicates, phosphates, nitrites, nitrates) form the mineral basis for primary production. Together with temperature and salinity hydrochemical parameters give evidence for the distribution of water masses and their temporal and spatial variability.

During the expedition, water for hydrochemical analyses was sampled out at 32 stations on standard levels (Fig. 65). The total number of samples for nutrients is 147. The concentration of dissolved oxygen was measured onboard in 170 samples. 223 samples for nutrient analyzing were taken to process in the OSL. 46 samples for CDOM and 200 samples for $\delta^{18}O$ were collected. For CDOM the samples were taken from top and bottom levels only. According to the first method the CDOM samples were immediately frozen at the temperature -20°C. According to the second method samples were filtered and stored in a cool place. CDOM will be analyzed in the OSL. The $\delta^{18}O$ samples were taken in dark glass bottles with hermetical covers and additionally isolated with wax. They will be transported to the IFM-GEOMAR for analysis.

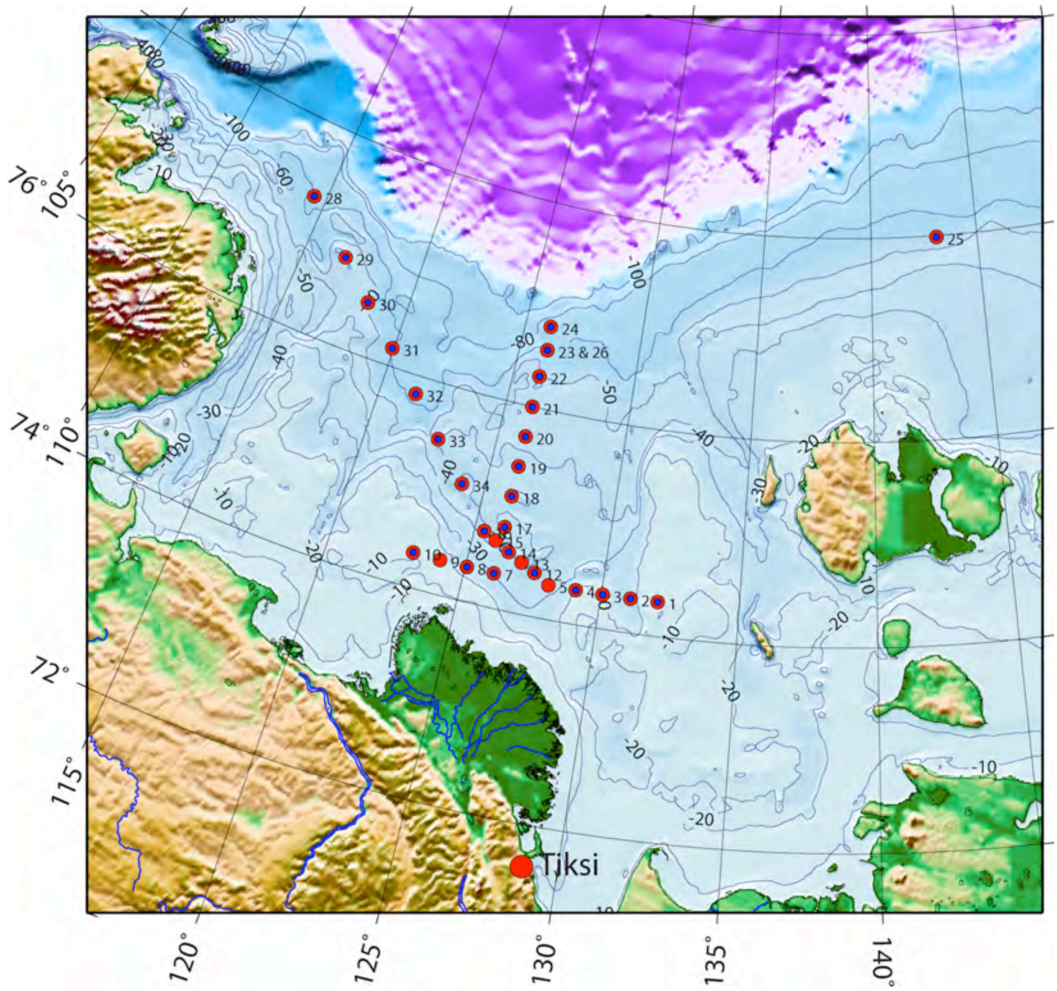


Fig. 65: Stations where water samples for oxygen and nutrients (red) and for $\delta^{18}O$ (blue) were taken.

Methods and equipment

The investigations at oceanographic stations included water sampling using the following equipment: CTD-sensor SBE 19 plus, cable-free rosette with 5-liter plastic water-sampling bottles, release for the opening of water-sampling bottles at certain depth levels, and oceanographic winch.

The water samples are used for measuring nutrient content, chlorophyll *a* concentration, suspended matter and organic carbon content, concentration of dissolved oxygen and oxygen isotope O^{18}. Dissolved oxygen, phosphates and silicates concentrations were measured onboard. The nutrient (phosphates, silicates, nitrites, nitrates) concentration, suspended matter and organic carbon content, and chlorophyll *a* concentration will be measured in the OSL.

The samples for oxygen concentration were taken first. Water was sampled into 100-ml glass bottles. After sampling the oxygen was fixed by sequential adding of 1 ml of manganese chloride and 1 ml of potassium iodide/sodium hydroxide solution. The sample was mixed until an evenly distributed precipitate was formed. Then it was dissolved by addition of 2 ml of sulfuric acid. The dissolved oxygen content was determined by titration with sodium thiosulphate using an electronic burette following the modified Winkler method (Oradovsky, 1993) with the use of an automatic burette ABU-80. The dissolved oxygen content was additionally measured with an SBE-43 sensor installed on the oceanographic SBE19 plus CTD sensor.

Water and sediment samples for nutrients were collected in 50 and 125 ml plastic bottles. Immediately after sampling the 50 ml bottles were frozen under -20ºC and later transported to the laboratory for further analysis. The 125 ml samples were added to Nessler cylinders with 35 ml for silicates and 50 ml for phosphates analysis. To the phosphate samples 4 ml of mixed reagent and 1 ml of ascorbic acid were added sequentially to get the color. After 10 minutes the samples were analyzed with a photo-colorimeter FC-3. To the silicates samples 1 ml of mixed reagent was added first. After 10 minutes 1 ml oxalic and 1 ml of ascorbic acid were added sequentially to the sample to get the color. The samples were analyzed after further 30 minutes with a photo-colorimeter FC-3.

First results

During the cruise 41 oceanographical stations were occupied in the Laptev Sea. The analysis of surface temperature and salinity distribution in the Laptev Sea revealed well pronounced river plume shift eastward from the Lena river delta and its insignificant expansion to the north (to 75°N) and east (to 124°E). Similar situation was observed in summer 2007. But the mixed layer at the transect 126°E in 2009 (Fig. 66) is thicker than in summer 2007. The mixed layer in 2009 is about 16-18 m thick which is similar with the historical data. Surface water temperature is 0.5°C higher and salinity is 2 psu higher than the multiannual mean values. There is well pronounced pycnocline and bottom water mass of the Laptev Sea central part reach the 74°25'N latitude. According to the cruise data the bottom water mass temperature is -1.5°C which is 0.5°C lower than climatic values. There is a signal of Atlantic waters influence in northern part of the transect at depths more than 40 m. It could be observed to the latitude 76°30'N.

Temperature and salinity distribution at the transect 74°20'N also demonstrate the shift of river plume eastward. There are two well recognized cores of winter bottom water masses expanding southward along the bottom depressions.

There are similar river plume patterns observed in September 2007 and 2009. As one of the features of hydrological parameters distribution in September 2009 the bottom water mass temperature decreasing could be noted. The structural elements distribution and ranges of parameters observed in 2009 coincide with the multiannual data.

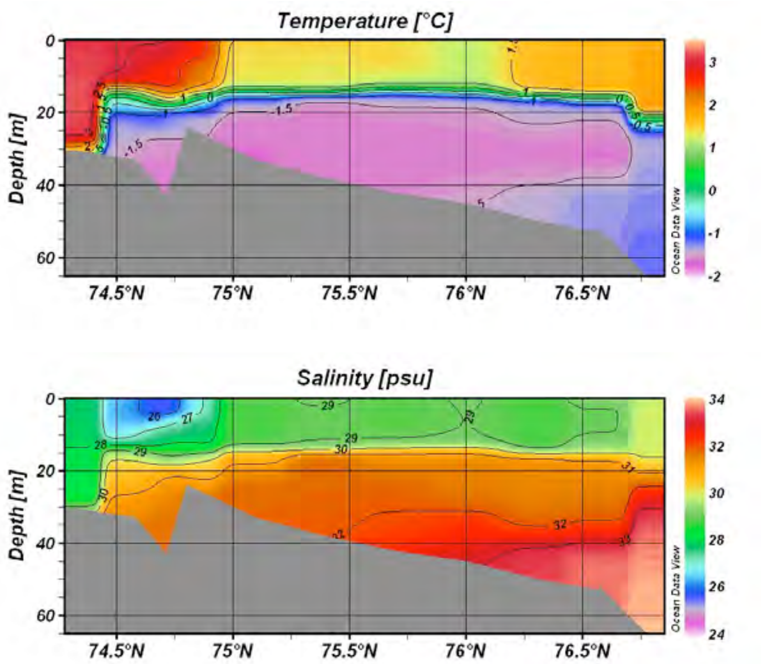


Fig. 66: Temperature and salinity distribution along the 126°E transect in September 2009.

Sediment dynamics

K. Wittbrodt
Leibniz Institute of Marine Sciences IFM-GEOMAR, Kiel, Germany

The distribution and dynamics of suspended particulate matter (SPM) influence the primary production in terms of availability of nutrients and the absorption of light. Changes in the SPM concentration and distribution might have serious effects on the sensitive Arctic ecosystem, e.g., increased SPM concentration via sediment resuspension and river discharge might impede primary production by limiting light penetration.

Methods and equipment

To investigate the vertical and horizontal distribution of SPM as well as their dynamics in comparison to summer 2007 and 2008 on the Laptev Sea shelf turbidity measurements were carried out along a grid of 35 short- and long-term stations (Fig. 67). A SEAPOINT turbidity meter connected to a CTD was used in order to obtain data on SPM, salinity, and temperature distribution in the water column. The turbidity meter emits light of 880 nm wavelength with a constant output time of 0.1 sec. It detects light scattered by particles within the water column

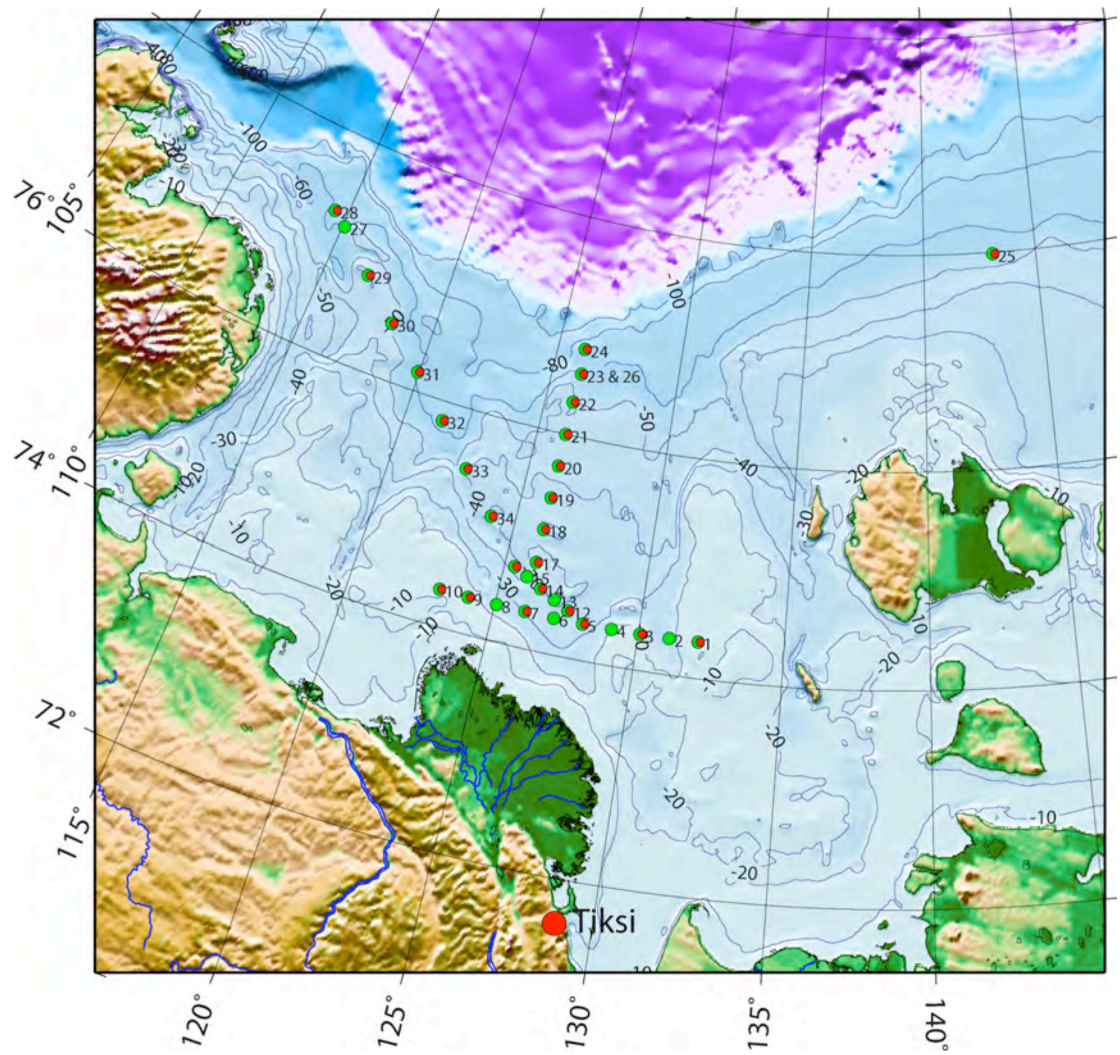


Fig. 67: Stations where water samples for direct SPM measurement were taken (red) and stations where the turbidity meter measured SPM indirectly (green).

and generates an output voltage proportional to particles in the water column. The output is given in Formazine Turbidity Unit (FTU), a calibration unit based on formazine as a reference suspension. In order to estimate the SPM concentration from the turbidity meter signal water samples of 0.5 l each were taken from defined water depths (see sampling list in appendix for details). These water samples have been filtered through pre-weighed HVLP filters by MILLIPORE (0.45 microns) to obtain SPM concentration. All SPM concentrations obtained from water samples (SPM_{filter}) ≤0.3mg l^{-1} were set to 0.3 mg l^{-1}, as the elutable portion of the used filters is <0.3 mg l^{-1}. All turbidity measurements will be correlated with corresponding *in situ* water samples to obtain accuracy by taking the effects of different mineralogy, varying particle darkness, and salinity of ambient water on the response of the turbidity meter into account (Sutherland et al., 2000).

First Results

During the ice-free months in 2009 the Lena River water was mainly transported towards the east due to prevailing westerly winds, leading to increased surface salinities on the mid and outer shelf, comparable to the situation in summer 2007 (Fig. 68). During these so-called “onshore years” (Dmitrenko et al., 2008a; Bauch et al., 2009) the freshwater export to the East Siberian Sea can be as high as 500 km^3 (Dmitrenko et al., 2008a). Generally the surface SPM distribution in summer on the Laptev Sea shelf is linked to the dispersion of the freshwater plume of the River Lena (Wegner et al., 2005). The turbidity measurements on the inner eastern shelf show clearly increased backscatter signals in comparison to the mid-shelf area, implicating an increased SPM transport towards the East Siberian Sea. But so far the impact of “off-shore” conditions and the associated export of SPM towards the east on the sediment budget of the Laptev Sea shelf is unknown.

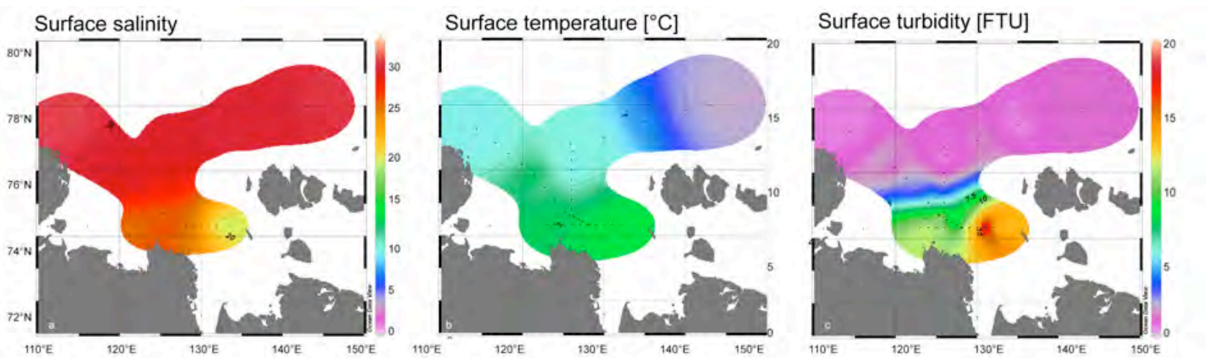


Fig. 68: Surface salinity (a), surface temperature [°C] (b), and surface turbidity [FTU] (c) as a measure of SPM concentration during TRANSDRIFT XVI. High FTU represents high SPM concentration and vice versa.

Biological investigations

F. Martynov[1], D. Taborskiy[2]
[1]Arctic and Antarctic Research Institute, St. Petersburg, Russia
[2]Biological Faculty, St. Petersburg State University, St. Petersburg, Russia

The main aim of biological investigations during the expedition TRANDRIFT XVI was to collect comparative data on the structure of food webs and productivity of arctic marine ecosystems in the Laptev Sea.

The scientific goals of the biological investigations during this expedition were to:

- specify macrobenthos and plankton species in the Laptev Sea;
- clarify the distribution and quantitative characteristics of biocoenoses on the Laptev shelf;
- establish the distribution dependence of both benthic and pelagic biocoenoses on hydrological and hydrochemical characteristics;
- determine primary production in the basin of the polynya region using analyses of chlorophyll *a* and its distribution in the Laptev Sea;
- estimate interannual and seasonal changes (according to the last expeditions to this region) in biota of the Laptev Sea.

During the expedition 48 plankton, 17 benthos and 200 chlorophyll *a* samples were taken (Fig. 69). These samples will allow us to continue our multiyear monitoring of the ecosystem of the Laptev Sea shelf. Analysis of the long-term data series allows indicating some trends/oscillations in the species composition and dynamics of the pelagic system and providing the background for further assessing ecosystem changes connected with climate variability in the Arctic region.

<u>Methods and equipment</u>

Chlorophyll a *sampling*

Water samples of 0.5 liters were collected with the carousel water sampler at standard water depths and were poured into plastic bottles. The water samples were processed on board and were filtered in the laboratory as follows:

- the water samples are filtered through Whatman GF/F filters (0.7 microns) with a pressure of <0.2 bars;
- after the water was filtered, the filters were put with tweezers in Eppendorf tubes marked with station and depth and immediately put in the freezer on board, with temperatures < -20ºC;
- after the freezer will have been transported to St. Petersburg, further processing of samples will take place in the OSL with the fluorimeter TD 700 and SPECORD 200.

Phytoplankton sampling

Phytoplankton samples were taken woth an Apstein net with a diameter of 20 cm and meshsize of 20 µm. The depth levels of all the samples were below the pycnocline. As the next step the samples were poured into plastic bottles and fixed with 4% neutral formalin. The samples will be further processed at the OSL and Moscow State University.

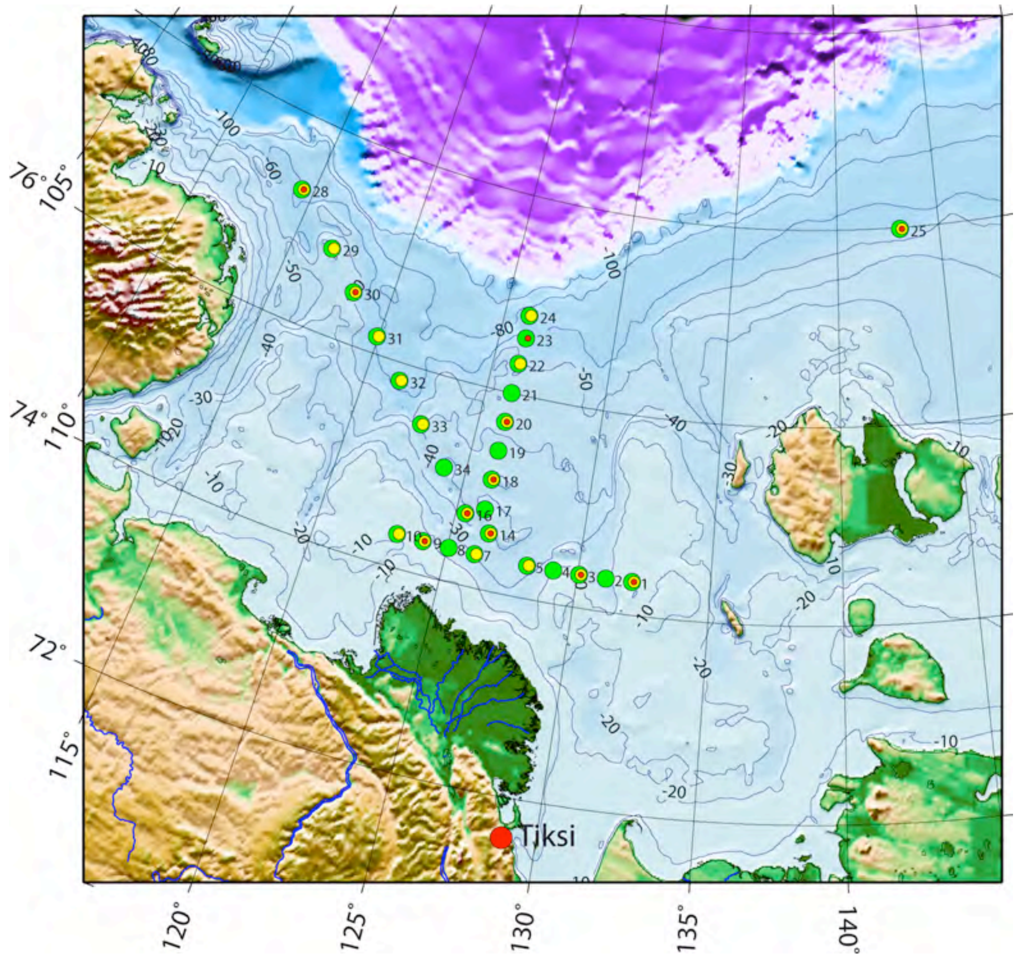


Fig. 69: Stations where macro/meiobenthos (red), zoo/phytoplankton (yellow) and chlorophyll *a* (green) samples were taken.

Zooplankton sampling

Zooplankton samples were taken with an Apstein net with a diameter of 40 cm and meshsize of 200 µm. The depths levels of all taken samples were below the pycnocline as well as the total water column from bottom to top. After that samples were poured into plastic bottles and fixed with 4% neutral formalin. The samples will be further processed at the OSL.

Macrobenthos sampling

Samples were taken with a modified pneumatic Van Veen Grab with a working area of 0.09 m². The samples were washed on two sieves with meshsizes of 1 and 0.5 mm. After washing, the samples were fixed in 76% pure alcohol in plastic bottles. The samples will be further processed at the OSL and St. Petersburg State University.

Meiobenthos sampling

Samples were taken with a modified pneumatic Van Veen Grab with a working area of 0.09 m^2. The upper 1 cm layers from the area of 0.01 m^2 of each sample were taken. The samples were fixed in 76% Rose Bengal alcohol in plastic bottles. They will be further processed at Moscow State University.

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III. APPENDIX

- Lists of participating institutions and scientists
- Station lists
- Detailed core descriptions (TRANSDRIFT XII)

Lists of participating institutions and scientists

- TRANSDRIFT XII

No.	Name	Affiliation
1	Abramova, Ekaterina	State Lena Delta Reserve, Tiksi
2	Bloshkina, Ekaterina	AARI, St. Petersburg
3	Bogin, Viktor	VNIIOkeangeologia, St. Petersburg
4	Bol’shchikov, Vladimir	VNIIOkeangeologia, St. Petersburg
5	Ermakova, Liviya	P.P. Shirshov Institute of Oceanology RAS, Moscow
6	Gottschalk, Julia	Bremen University
7	Groeger, Matthias	Mainz Academy of Sciences, Humanities and Literature / IFM-GEOMAR, Kiel
8	Gukov, Alexander	Lena Delta Nature Reserve, Tiksi
9	Hoelemann, Jens	AWI, Bremerhaven
10	Isenberg, Marc-Andre	IFM-GEOMAR, Kiel
11	Kassens, Heidemarie	IFM-GEOMAR, Kiel
12	Klagge, Torben	IFM-GEOMAR, Kiel
13	Komar’, Pavel	VNIIOkeangeologia, St. Petersburg
14	Krumpen, Thomas	AWI, Bremerhaven
15	Kuz’min, Sergey	AARI, St. Petersburg
16	Martynov, Fedor	St. Petersburg State University
17	Morozova, Olga	AARI, St. Petersburg
18	Novikhin, Andrey	AARI, St. Petersburg
19	Portnov, Aleksey	VNIIOkeangeologia, St. Petersburg
20	Rekant, Pavel	VNIIOkeangeologia, St. Petersburg
21	Rukhovets, Konstantin	AARI, St. Petersburg
22	Slagoda, Elena	VNIIOkeangeologia, St. Petersburg
23	Toupenets, Andrey	AARI, St. Petersburg
24	Vlasenkov, Roman	AARI, St. Petersburg
25	Zakharov, Vladimir	VNIIOkeangeologia, St. Petersburg

- TRANSDRIFT XIV

No.	Name	Affiliation
1	Bloshkina, Ekaterina	AARI, St. Petersburg
2	Ermakova, Liviya	P.P. Shirshov Institute of Oceanology RAS, Moscow
3	Hoelemann, Jens	AWI, Bremerhaven
4	Klagge, Torben	IFM-GEOMAR, Kiel
5	Kolmakov, Aleksey	AARI, St. Petersburg
6	Martynov, Fedor	St. Petersburg State University
7	Novikhin, Andrey	AARI, St. Petersburg
8	Rozhkova, Anna	Hydrometeorological Institute, St. Petersburg
9	Ryndin, Alexander	POMOR/St. Petersburg State University
10	Sergienko, Igor	POMOR/St. Petersburg State University
11	Sosnin, Alexander	POMOR/St. Petersburg State University
12	Taborskiy, Dmitry	St. Petersburg State University
13	Vlasenkov, Roman	AARI, St. Petersburg

- TRANSDRIFT XVI

No.	Name	Affiliation
1	Dobrotina, Elena	AARI, St. Petersburg
2	Gukov, Alexandr	State Lena Delta Reserve, Tiksi
3	Klagge, Torben	IFM-GEOMAR, Kiel
4	Martynov, Fedor	AARI, St. Petersburg
5	Mengis, Nadine	IFM-GEOMAR, Kiel
6	Novikhin, Andrey	AARI, St. Petersburg
7	Ryzhov, Ivan	AARI, St. Petersburg; POMOR/St. Petersburg State University
8	Taborskiy, Dmitry	AARI, St. Petersburg
9	Wittbrodt, Kerstin	IFM-GEOMAR, Kiel

- Station list TRANSDRIFT XII

Station #		Coordinates, start		Coordinates, end		Date	Time, start	Time, end	Depth	Activity	Sampling										
		Latitude	Longitude	Latitude	Longitude		(UTC)	(UTC)			Dissolved oxygen	Nutrients	CDOM	Chloro-phyll *a*	Zoo-plankton	Phyto-plankton	Meio-benthos	Macro-benthos	$\delta^{18}O$	Pore water	Suspen-ded matter
IP_2_001	2_094	72°30.060	131°00.421	72°29.929	131°01.357	29.08.2007	15.10	15.20	18.5	CTD, Rosette	4	4							4		
IP_2_002	2_095	73°00.124	131°00.409	73°00.182	131°00.869	29.08.2007	18.15	18.22	24.0	CTD, Rosette	5	5							5		
IP_2_003	2_096	73°30.136	131°00.445	73°30.187	131°00.514	29.08.2007	21.28	21.35	24.0	CTD, Rosette									7		
IP_2_004	2_097	74°00.091	130°59.813	74°00.072	130°58.997	30.08.2007	00.36	00.43	21.5	CTD, Rosette									5		
IP_2_043P	2_098P	74°20.021	128°59.937	74°20.115	128°59.811	30.08.2007	04.32	04.40	18.0	CTD, Rosette, Net, Box Corer	5	5	2	5	2		1	1	6	3	4
IP_2_044P	2_099P	74°30.128	128°59.797	74°30.142	128°59.213	30.08.2007	06.29	06.40	36.0	CTD, Rosette		8									
IP_2_045P	2_100P	74°40.111	128°59.785	74°40.045	128°59.785	30.08.2007	07.50	08.05	35.5	CTD, Rosette		8							8		
IP_2_046P	2_101P	74°50.098	128°59.792	74°50.117	128°59.090	30.08.2007	09.10	09.20	37.5	CTD, Rosette, Net, Box Corer	8	8	2	8	2		4	1	9	3	
IP_2_047P	2_102P	75°00.174	128°59.671	75°00.177	128°59.000	30.08.2007	11.44	11.52	38.0	CTD, Rosette		8							9		
IP_2_048P	2_103P	75°10.157	129°00.471	75°10.178	129°00.128	30.08.2007	13.15	13.25	37.0	CTD, Rosette		8									
IP_2_049P	2_104P	75°20.165	129°00.344	75°20.377	129°00.289	30.08.2007	14.44	14.54	38.5	CTD, Rosette, Net, Box Corer	8	8	2	8	2		4	1	9	3	
IP_2_036P	2_105P	75°19.739	127°59.705	75°19.545	127°59.561	30.08.2007	18.05	18.15	40.0	CTD, Rosette, Net	8	8		8	2				9		
IP_2_037P	2_106P	75°09.946	128°00.146	75°09.768	128°00.008	30.08.2007	19.50	20.00	39.0	CTD, Rosette		8									
IP_2_038P	2_107P	74°59.894	127°59.818	74°59.822	127°59.437	30.08.2007	21.10	21.20	34.0	CTD, Rosette		9							9		
IP_2_039P	2_108P	74°49.900	127°59.777	74°49.724	127°59.177	30.08.2007	22.27	22.35	30.0	CTD, Rosette, Net	7	7		7	2				7		
IP_2_040P	2_109P	74°40.017	128°00.278	74°40.186	128°00.238	30.08.2007	23.57	24.07	32.0	CTD, Rosette		7							9		
IP_2_041P	2_110P	74°30.036	128°00.983	74°30.088	128°01.552	31.08.2007	01.31	01.41	34.5	CTD, Rosette, Net		8									
IP_2_042P	2_111P	74°19.991	128°00.396	74°19.999	128°00.668	31.08.2007	03.13	03.22	33.0	CTD, Rosette, Net	7	7		7	2				9		7
IP_2_029P	2_112P	74°19.940	126°59.906	74°19.646	126°59.406	31.08.2007	16.58	17.08	33.5	CTD, Rosette, Net	7	7		7	2				8		7
IP_2_030P	2_113P	74°30.115	127°00.319	74°29.827	127°01.006	31.08.2007	18.49	18.58	21.5	CTD, Rosette		5									
IP_2_031P	2_114P	74°39.683	127°00.898	74°39.285	127°01.504	31.08.2007	20.46	20.56	25.0	CTD, Rosette		5							5		
IP_2_032P	2_115P	74°50.050	127°00.648	74°49.962	127°01.096	01.09.2007	00.19	00.28	33.0	CTD, Rosette, Net	7	7		7	2				8		
IP_2_033P	2_116P	75°00.166	127°00.630	75°00.024	127°01.593	01.09.2007	02.40	02.48	35.0	CTD, Rosette		6							9		
IP_2_034P	2_117P	75°10.131	127°00.382	75°09.958	127°01.012	01.09.2007	04.35	04.44	35.0	CTD, Rosette, Net		8									
IP_2_035P	2_118P	75°20.054	127°00.546	75°19.899	127°01.303	01.09.2007	06.09	06.20	36.5	CTD, Rosette, Net, Box Corer	8	8	2	8	2			1	8	3	
IP_2_022P	2_119P	75°20.122	125°99.730	75°20.000	126°00.253	01.09.2007	08.16	08.26	39.0	CTD, Rosette, Net	8	8		8	2				8		8
IP_2_023P	2_120P	75°10.012	126°01.633	75°10.081	126°01.633	01.09.2007	11.29	11.39	34.5	CTD, Rosette		7									7
IP_2_024P	2_121P	75°00.025	126°00.100	75°00.039	126°00.086	01.09.2007	13.00	13.10	34.0	CTD, Rosette		7							7		7
IP_2_025P	2_122P	74°49.987	126°00.384	74°49.927	126°01.077	01.09.2007	16.18	16.25	27.0	CTD, Rosette, Net, Box Corer	6	6	2	6	2		4	1	6	3	6

Station #		Coordinates, start		Coordinates, end		Date	Time, start	Time, end	Depth	Activity	Sampling										
		Latitude	Longitude	Latitude	Longitude		(UTC)	(UTC)			Dissolved oxygen	Nutrients	CDOM	Chloro-phyll *a*	Zoo-plankton	Phyto-plankton	Meio-benthos	Macro-benthos	$\delta^{18}O$	Pore water	Suspen-ded matter
IP_2_026P	2_123P	74°39.927	125°59.775	74°39.858	125°59.611	01.09.2007	17.42	17.50	33.5	CTD, Rosette		8							9		8
IP_2_027P	2_124P	74°29.845	126°00.423	74°29.567	126°00.549	01.09.2007	19.06	19.15	38.5	CTD, Rosette		9							9		8
IP_2_028P	2_125P	74°19.897	126°00.197	74°19.734	125°59.904	01.09.2007	20.23	20.31	31.0	CTD, Rosette, Net, Box Corer	7	7	2	7	2		4	1	8	3	7
IP_2_001M	2_126	74°20.025	128°01.104	74°20.023	128°01.107	02.09.2007	07.30	07.40	32.5	CTD, Rosette											7
IP_2_015P	2_127P	74°19.955	124°59.135	74°19.961	124°59.135	02.09.2007	12.24	12.34	23.0	CTD, Rosette, Net	5	5		5	2				5		5
IP_2_016P	2_128P	74°30.142	125°00.273	74°30.182	125°00.309	02.09.2007	13.58	14.08	32.5	CTD, Rosette		7									
IP_2_017P	2_129P	74°40.129	125°00.239	74°40.049	125°00.576	02.09.2007	15.21	15.32	37.5	CTD, Rosette		8							8		
IP_2_018P	2_130P	74°50.101	125°00.355	74°49.951	125°00.634	02.09.2007	16.54	17.07	43.0	CTD, Rosette, Net	8	8		8	2				8		
IP_2_119P	2_131P	75°00.024	125°00.108	74°59.792	124°59.572	02.09.2007	18.59	19.07	39.5	CTD, Rosette		8							9		
IP_2_020P	2_132P	75°09.992	125°00.454	75°09.930	125°00.541	02.09.2007	20.54	21.00	39.5	CTD, Rosette		8									
IP_2_021P	2_133P	75°20.043	125°00.415	75°19.869	125°00.392	02.09.2007	22.50	22.57	41.0	CTD, Rosette, Net	8	8		8	2				8		
IP_2_008P	2_134P	75°20.132	123°59.828	75°20.088	124°00.477	03.09.2007	01.04	01.10	40.0	CTD, Rosette, Net	8	8		8	2				8		
IP_2_009P	2_135P	75°09.963	124°00.385	75°09.810	124°00.615	03.09.2007	02.41	02.48	47.5	CTD, Rosette		9							9		
IP_2_010P	2_136P	74°59.877	124°00.586	74°59.746	124°00.732	03.09.2007	04.13	04.21	48.5	CTD, Rosette		9							11		
IP_2_011P	2_137P	74°49.973	124°00.541	74°49.812	124°01.073	03.09.2007	05.30	05.40	37.0	CTD, Rosette, Net	8	8		8	2				8		
IP_2_002M	2_138	74°43.033	125°17.529	74°43.020	125°17.415	03.09.2007	13.43	13.55	43.0	CTD, Rosette											8
IP_2_012P	2_139P	74°40.120	124°00.099	74°40.015	124°01.187	03.09.2007	16.16	16.26	33.0	CTD, Rosette		7							7		
IP_2_013P	2_140P	74°29.596	124°00.544	74°29.869	124°01.276	03.09.2007	17.31	17.37	21.0	CTD, Rosette		5									
IP_2_014P	2_141P	74°19.886	124°00.502	74°19.708	124°01.083	03.09.2007	18.49	18.54	17.0	CTD, Rosette, Net	4	4		4	2				5		4
IP_2_001P	2_142P	74°20.063	123°00.078	74°19.817	123°00.179	03.09.2007	21.05	21.09	13.0	CTD, Rosette, Net, Box Corer	4	4	2	4	2			1	4	3	3
IP_2_002P	2_143P	74°30.051	123°00.429	74°29.909	123°00.715	03.09.2007	23.26	23.30	16.0	CTD, Rosette		4							4		
IP_2_003P	2_144P	74°40.157	123°00.283	74°40.074	123°01.049	04.09.2007	01.49	01.53	14.0	CTD, Rosette		3							4		
IP_2_004P	2_145P	74°50.121	123°00.729	74°49.966	123°01.682	04.09.2007	04.02	04.08	28.0	CTD, Rosette, Net, Box Corer	5	5	2	5	2		3	1	8	3	
IP_2_005P	2_146P	75°00.036	123°00.170	74°59.812	123°01.006	04.09.2007	09.05	09.11	28.0	CTD, Rosette		6							7		
IP_2_006P	2_147P	75°10.085	122°59.936	75°09.972	123°00.830	04.09.2007	12.31	12.39	42.0	CTD, Rosette		8							7		
IP_2_007P	2_148P	75°20.086	123°00.493	75°20.006	123°01.336	04.09.2007	14.38	14.48	49.0	CTD, Rosette, Net	9	9	2	9	2				7		
IP_2_050P	2_149P	74°15.059	123°30.929	74°15.012	123°31.658	04.09.2007	21.55	21.59	11.0	CTD, Rosette, Net	3	3		3	2				8		
IP_2_051P	2_150P	74°10.003	124°00.740	74°09.982	124°01.819	04.09.2007	23.17	23.21	13.0	CTD, Rosette, Net		4		4	2						
IP_2_052P	2_151P	74°10.084	125°00.440	74°10.063	125°01.580	05.09.2007	01.04	01.08	16.0	CTD, Rosette		4							4		
IP_2_053P	2_152P	74°10.062	126°00.400	74°10.055	126°01.461	05.09.2007	02.42	02.46	21.0	CTD, Rosette, Net	5	5		5	2						5
IP_2_054P	2_153P	74°10.040	127°00.077	74°10.029	127°01.161	05.09.2007	04.31	04.36	30.0	CTD, Rosette		7							9		
IP_2_055P	2_154P	74°10.108	128°00.820	74°10.089	128°00.796	05.09.2007	06.17	06.23	29.0	CTD, Rosette, Net		6		6	2						
IP_2_056P	2_155P	74°10.143	129°00.565	74°10.237	129°01.252	05.09.2007	10.25	10.30	14.0	CTD, Rosette	3	3							3		

Station #		Coordinates, start		Coordinates, end		Date	Time, start	Time, end	Depth	Activity	Sampling										
		Latitude	Longitude	Latitude	Longitude		(UTC)	(UTC)			Dissolved oxygen	Nutrients	CDOM	Chloro-phyll *a*	Zoo-plankton	Phyto-plankton	Meio-benthos	Macro-benthos	$\delta^{18}O$	Pore water	Suspen-ded matter
IP_2_057P	2_156P	74°10.121	130°00.499	74°10.218	130°00.899	05.09.2007	12.24	12.30	15.0	CTD, Rosette, Net	3	3		3	2				3		
IP_2_058P	2_157P	74°20.160	130°00.320	74°20.165	130°00.954	05.09.2007	13.59	14.04	20.0	CTD, Rosette		4							4		4
IP_2_059P	2_158P	74°30.053	129°59.923	74°30.243	129°00.340	05.09.2007	15.21	15.28	31.0	CTD, Rosette, Net	7	7		7	2						
IP_2_060P	2_159P	74°40.152	129°59.134	74°40.139	129°59.471	05.09.2007	16.50	16.57	31.0	CTD, Rosette		7							7		
IP_2_061P	2_160P	74°50.222	129°59.842	74°50.412	129°59.791	05.09.2007	18.24	18.31	35.0	CTD, Rosette, Net	8	8		8	2				8		
IP_2_062P	2_161P	75°00.207	129°59.906	75°00.308	129°59.485	05.09.2007	19.55	20.02	39.0	CTD, Rosette		8							8		
IP_2_063P	2_162P	75°10.138	130°00.028	75°10.255	129°59.637	05.09.2007	21.10	21.16	42.0	CTD, Rosette, Net	8	8		8	2				9		
IP_2_064P	2_163P	75°20.125	129°59.786	75°20.301	129°59.464	05.09.2007	22.42	22.49	44.0	CTD, Rosette, Net	9	9		9	2				9		
IP_2_005	2_164	75°59.936	143°00.464	75°59.784	143°00.588	06.09.2007	23.18	23.22	23.0	CTD, Rosette, Net	5	5	2	5	2				7		5
IP_2_006	2_165	76°30.086	143°00.573	76°29.977	143°00.364	07.09.2007	04.25	04.30	28.0	CTD, Rosette, Net	6	6	2	6	2				8		6
IP_2_007	2_166	76°59.943	143°00.625	76°59.634	143°00.924	07.09.2007	10.01	10.08	32.0	CTD, Rosette, Net	7	7	2	7	2				7		7
IP_2_008	2_167	77°30.019	143°00.387	77°29.775	142°59.459	07.09.2007	15.38	15.46	40.0	CTD, Rosette, Net	8	8	2	8	2				8		8
IP_2_009	2_168	77°59.426	143°01.322	77°59.759	143°02.042	07.09.2007	21.31	21.39	51.0	CTD, Rosette, Net	9	10	2	10	2				10		10
IP_2_011	2_169	79°00.025	142°59.308	79°00.112	142°59.311	08.09.2007	18.34	18.50	122.0	CTD, Rosette, Net	11	11	2	11	2				10		11
IP_2_010	2_170	78°29.899	143°01.185	78°29.667	143°02.388	08.09.2007	22.55	23.04	68.0	CTD, Rosette, Net	10	10	2	10	2				11		10
IP_2_012	2_171	77°45.093	138°59.680	77°45.343	139°00.383	09.09.2007	06.31	06.40	48.0	CTD, Rosette, Net	9	9	2	9	2				9		9
IP_2_013	2_172	77°10.025	135°54.706	77°10.100	135°54.493	09.09.2007	12.44	12.53	37.0	CTD, Rosette, Net	8	8	2	8	2				8		7
IP_2_014	2_173	76°29.972	132°09.668	76°30.184	132°09.220	09.09.2007	20.22	20.29	51.0	CTD, Rosette, Net	9	9	2	9	2				9		8
IP_2_015	2_174	76°29.996	129°59.947	76°30.122	129°59.454	10.09.2007	00.09	00.17	57.0	CTD, Rosette, Net	9	9	2	9	2				10		8
IP_2_004L_1	2_175	76°43.839	125°54.829	76°43.836	125°54.831	10.09.2007	11.17	11.26	62.0	CTD, Net	10	10	2	10	6				10		
IP_2_004L_2	2_176	76°43.835	125°54.818	76°43.832	125°54.804	10.09.2007	13.56	14.05	62.0	CTD, Net					6						
IP_2_004L_3	2_177	76°43.828	125°54.798	76°43.821	125°54.774	10.09.2007	16.57	17.06	62.0	CTD, Net					6						
IP_2_004L_4	2_178	76°43.828	125°54.761	76°43.823	125°54.757	10.09.2007	19.58	20.05	62.0	CTD, Net					6						
IP_2_004L_5	2_179	76°43.830	125°54.800	76°43.934	125°55.052	10.09.2007	23.08	23.16	62.0	CTD, Rosette, Net	10	10		10	6				10		
IP_2_004L_6	2_180	76°43.834	125°54.781	76°43.836	125°54.777	11.09.2007	01.58	02.07	62.0	CTD, Net					6						
IP_2_004L_7	2_181	76°43.827	125°54.744	76°43.829	125°54.757	11.09.2007	04.57	05.07	62.0	CTD, Net					6						
IP_2_004L_8	2_182	76°43.829	125°54.716	76°43.828	125°54.723	11.09.2007	07.52	08.01	62.0	CTD, Net					6						
IP_2_004L_9	2_183	76°43.828	125°54.732	76°43.827	125°54.739	11.09.2007	10.57	10.08	62.0	CTD, Rosette, Net, Box Corer	10	10		10	6		4	1	10	3	
IP_2_005L	2_184	77°14.857	126°00.247	77°14.376	125°59.195	11.09.2007	17.16	17.44	1260.0	CTD, Rosette, Net	12	12	2	12	2				12		11
IP_2_002L	2_185	76°19.946	126°00.372	76°19.768	126°00.120	12.09.2007	02.28	02.35	47.0	CTD, Rosette, Net, Box Corer	10	10	2	10	2		4	1	9	3	
IP_2_0105L	2_186	75°49.871	125°59.717	75°49.739	125°58.416	12.09.2007	07.19	07.28	44,0	CTD, Rosette, Net, Box Corer	8	8	2	8	2		4	1	8		3
IP_2_022L	2_187	75°20.008	126°00.207	75°19.857	125°59.811	12.09.2007	12.32	12.39	38,5	CTD, Rosette, Net	8	8		8	2				8		
IP_2_016	2_188	74°34.030	139°16.750	74°33.791	139°16.634	16.09.2007	06.17	06.22	15.0	CTD, Rosette, Net	3	3		3	2				3		

Station #		Coordinates, start		Coordinates, end		Date	Time, start	Time, end	Depth	Activity	Sampling										
		Latitude	Longitude	Latitude	Longitude		(UTC)	(UTC)			Dissolved oxygen	Nutrients	CDOM	Chloro-phyll *a*	Zoo-plankton	Phyto-plankton	Meio-benthos	Macro-benthos	$\delta^{18}O$	Pore water	Suspen-ded matter
IP_2_017	2_189	74°27.011	139°40.864	74°27.044	139°41.845	16.09.2007	07.42	07.50	28.5	CTD, Rosette, Net, Box Corer	6	6	2	6	2		4	1	6	3	
IP_2_018	2_190	74°19.002	140°07.499	74°19.066	140°08.183	16.09.2007	10.49	10.54	16.0	CTD, Rosette, Net	4	4		4	2				4		
IP_2_019	2_191	73°16.317	140°03.709	73°16.421	140°04.294	16.09.2007	19.50	19.53	13.0	CTD, Rosette, Net	3	3		4	2				3		
IP_2_020	2_192	73°05.951	140°20.185	73°05.886	140°19.902	16.09.2007	21.20	21.23	15.0	CTD, Rosette, Net, Box Corer	4	4	2	6	2		4	1	4	3	
IP_2_021	2_193	72°59.893	140°30.400	72°59.824	140°30.095	16.09.2007	22.44	22.47	12.5	CTD, Rosette, Net	3	3		3	2				4		
IP_2_022	2_194	72°45.033	139°07.946	72°45.161	139°08.173	17.09.2007	01.54	01.58	15.0	CTD, Rosette, Net, Box Corer	4	4	2	4	2		4	1	4	3	
IP_2_023	2_195	72°35.368	137°31.573	72°35.442	137°32.472	17.09.2007	06.12	06.17	24.0	CTD, Rosette, Net	6	6		6	2				6		
IP_2_024	2_196	72°25.076	135°55.001	72°25.166	135°56.053	17.09.2007	10.37	10.43	22.5	CTD, Rosette, Net, Box Corer	5	5	2		2		4	1	5	3	
IP_2_025	2_197	72°15.067	134°20.047	72°15.065	134°20.819	17.09.2007	16.16	16.22	21.5	CTD, Rosette, Net	5	5			2				5		
IP_2_026	2_198	72°03.117	132°45.144	72°03.160	132°45.749	17.09.2007	20.03	20.08	17.0	CTD, Rosette, Net	4	4	2		1				4		

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Station #	Latitude	Longitude	Date	Time UTC	Activity	Sampling										
						Dissolved oxygen	**Nutri-ents**	**CDOM**	**Chloro-phyll *a***	**Zoo-plank-ton**	**Phyto-plank-ton**	**Meio-ben-thos**	**Macro-benthos**	**$\delta^{18}O$**	**Suspen-ded matter**	**Suspended matter (calibration)**
IP08_2_133	71°30.001	131°00.150	05.09.2008	16.08	CTD, Rosette	3	3									
IP08_2_134	72°00.054	131°00.323	05.09.2008	19.50	CTD, Rosette											4
IP08_2_135	72°29.054	131°00.023	05.09.2008	23.30	CTD, Rosette	4	4									4
IP08_2_136	72°59.962	131°00.059	06.09.2008	03.05	CTD											
IP08_2_137	73°30.031	130°59.644	06.09.2008	07.43	CTD, Rosette	5	5	2							2	
IP08_2_138	74°00.05	130°59.9	06.09.2008	11.56	CTD, Rosette			2							2	
IP08_2_139P	74°20.085	132°00.007	06.09.2008	15.15	CTD, Rosette, Boxcorer, Net	3	3	2	3	2	1		1	3	2	
IP08_2_140P	74°20.025	130°59.746	06.09.2008	18.01	CTD			2							2	
IP08_2_141P	74°19.950	129°59.574	06.09.2008	20.05	CTD, Rosette, Boxcorer, Net	5	5	2	5	2	1		1	5	2	3
IP08_2_142P	74°19.983	128°59.852	06.09.2008	22.55	CTD			2							2	
IP08_2_143P	74°19.971	127°59.452	07.09.2008	00.50	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1		1	7	2	4
IP08_2_144P	74°19.969	126°59.909	07.09.2008	03.55	CTD											
IP08_2_145M	74°19.937	128°00.216	07.09.2008	06.30	CTD, Rosette											2
IP08_2_146	74°09.870	128°00.124	07.09.2008	09.10	CTD, Rosette, Boxcorer, Net	6	6		6	2	1	1	1	6		4
IP08_2_147P	74°19.962	125°59.671	07.09.2008	13.55	CTD, Rosette, Boxcorer, Net	7	7		7	2	1	1	1	7		4
IP08_2_148P	74°19.979	124°59.866	07.09.2008	17.36	CTD											
IP08_2_149P	74°19.999	123°59.811	07.09.2008	19.30	CTD, Rosette, Boxcorer, Net	4	4		4	2	1		1	4		3
IP08_2_150P	74°20.019	122°59.843	07.09.2008	22.05	CTD											
IP08_2_151P	74°30.093	122°59.932	07.09.2008	23.25	CTD, Rosette, Boxcorer, Net	4	4	2	4	2	1		1	4	2	3
IP08_2_152P	74°29.899	124°00.036	08.09.2008	02.40	CTD											
IP08_2_153P	74°29.983	125°00.229	08.09.2008	04.30	CTD, Rosette, Boxcorer, Net	7	7		7	2	1	1	1	7		4
IP08_2_154M	74°42.973	125°17.462	08.09.2008	08.16	CTD, Rosette											5
IP08_2_155P	74°29.945	126°00.087	08.09.2008	10.49	CTD											
IP08_2_156P	74°30.095	126°59.830	08.09.2008	13.06	CTD, Rosette, Boxcorer, Net	5	5		5	2	1		1	5		3
IP08_2_157P	74°30.017	128°00.198	08.09.2008	17.37	CTD											
IP08_2_158P	74°30.005	128°59.945	08.09.2008	20.05	CTD, Rosette, Boxcorer, Net	8	8	2	8	2	1	1	1	8	2	4
IP08_2_159P	74°30.077	129°59.787	08.09.2008	23.45	CTD											
IP08_2_160P	74°29.988	130°59.930	09.09.2008	02.45	CTD, Rosette, Boxcorer, Net	6	6	2	6	2	1	1	1	6	2	4
IP08_2_161P	74°29.996	132°00.485	09.09.2008	08.13	CTD			2							2	
IP08_2_162P	74°40.106	131°59.698	09.09.2008	09.51	CTD, Rosette, Boxcorer, Net	4	4	2	4	2	1		1	4	2	3
IP08_2_163P	74°40.004	130°59.789	09.09.2008	12.30	CTD, Rosette			2							2	

Station #	Latitude	Longitude	Date	Time UTC	Activity	Sampling										
						Dissolved oxygen	Nutri-ents	CDOM	Chloro-phyll *a*	Zoo-plank-ton	Phyto-plank-ton	Meio-ben-thos	Macro-benthos	$\delta^{18}O$	Suspen-ded matter	Suspended matter (calibration)
IP08_2_164P	74°39.917	129°59.760	09.09.2008	14.28	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1	1	1	7	2	
IP08_2_165P	74°39.879	128°59.647	09.09.2008	17.11	CTD											
IP08_2_166P	74°39.998	127°59.710	09.09.2008	19.08	CTD, Rosette, Boxcorer, Net	7	7		7	2	1		1	7		4
IP08_2_167P	74°40.020	126°59.777	09.09.2008	22.00	CTD											
IP08_2_168P	74°39.959	125°59.415	09.09.2008	23.57	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1	1	1	7	2	4
IP08_2_169P	74°39.925	124°59.847	10.09.2008	02.54	CTD											
IP08_2_170P	74°39.960	123°59.862	10.09.2008	04.48	CTD, Rosette, Boxcorer, Net	7	7		7	2	1	1	1	7		4
IP08_2_171P	74°39.890	122°59.443	10.09.2008	07.42	CTD											
IP08_2_172P	74°50.044	123°00.284	10.09.2008	09.17	CTD, Rosette, Boxcorer, Net	6	6	2	6	2	1		1	6	2	4
IP08_2_173P	74°50.000	124°00.110	10.09.2008	12.33	CTD											
IP08_2_174P	74°49.951	124°59.452	10.09.2008	15.54	CTD, Rosette, Boxcorer, Net	8	8		8	2	1	1	1	8		4
IP08_2_175P	74°49.841	125°59.255	10.09.2008	18.17	CTD											
IP08_2_176P	74°50.024	127°00.136	10.09.2008	20.45	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1		1	7	2	4
IP08_2_177P	74°50.052	128°00.216	10.09.2008	23.55	CTD											
IP08_2_178P	74°49.932	129°00.046	11.09.2008	01.50	CTD, Rosette, Boxcorer, Net	8	8		8	2	1		1	8	2	4
IP08_2_179P	74°49.980	130°00.242	11.09.2008	04.40	CTD											
IP08_2_180P	74°50.003	131°00.282	11.09.2008	06.45	CTD, Rosette, Boxcorer, Net	6	6	2	6	2	1	1	1	6	2	4
IP08_2_181P	74°49.986	132°00.238	11.09.2008	10.43	CTD											
IP08_2_182P	75°00.058	132°00.175	11.09.2008	12.06	CTD, Rosette, Boxcorer, Net	4	4		4	2	1		1	4	2	3
IP08_2_183P	74°59.908	130°59.740	11.09.2008	14.51	CTD											
IP08_2_184P	74°59.943	129°59.261	11.09.2008	16.48	CTD, Rosette, Boxcorer, Net	8	8	2	8	2	1		1	8	2	4
IP08_2_185P	75°00.021	128°59.751	11.09.2008	20.40	CTD											
IP08_2_186P	74°59.975	128°00.223	11.09.2008	22.55	CTD, Rosette, Boxcorer, Net	7	7		7	2	1		1	7	2	4
IP08_2_187P	74°59.994	126°59.745	12.09.2008	02.05	CTD											
IP08_2_188M	74°19.854	128°00.301	12.09.2008	07.36	CTD, Rosette											6
IP08_2_189M	74°42.903	125°17.338	12.09.2008	13.47	CTD, Rosette											7
IP08_2_190P	75°00.000	126°00.180	12.09.2008	16.31	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1		1	7	2	4
IP08_2_191P	75°00.000	124°59.636	12.09.2008	20.05	CTD											
IP08_2_192	76°19.829	125°59.519	14.09.2008	5.45	CTD, Rosette	8	8		8					8	2	
IP08_2_193M	76°34.243	126°06.239	14.09.2008	11.05	CTD, Rosette	9	9		9					9	2	7
IP08_2_194	75°59.687	126°00.378	14.09.2008	15.44	CTD, Rosette	7	7		7					7	1	
IP08_2_195	76°29.788	130°00.380	15.09.2008	2.22	CTD, Rosette	9	9		9					9	2	
IP08_2_196	76°49.828	133°55.584	15.09.2008	10.06	CTD, Rosette, Boxcorer, Net	7	7		7	2	1		1	7	2	

Station #	Latitude	Longitude	Date	Time UTC	Activity	Sampling										
						Dissolved oxygen	Nutri-ents	CDOM	Chloro-phyll *a*	Zoo-plank-ton	Phyto-plank-ton	Meio-ben-thos	Macro-benthos	$\delta^{18}O$	Suspen-ded matter	Suspended matter (calibration)
IP08_2_197	77°10.876	135°28.207	15.09.2008	14.37	CTD, Rosette, Boxcorer, Net	8	8		8	2	1		1	8	2	
IP08_2_198	77°29.977	137°14.622	15.09.2008	19.58	CTD, Rosette, Boxcorer, Net	8	8		8	2	1	1	1	8	2	
IP08_2_199	77°48.003	139°01.036	15.09.2008	00.37	CTD, Rosette, Boxcorer, Net	9	9		9	2			1	9	2	
IP08_2_200	78°05.001	140°45.025	16.09.2008	00.37	CTD, Rosette, Boxcorer, Net	9	9		9	2	1		1	9	2	
IP08_2_201M	77°59.692	143°00.922	16.09.2008	10.59	CTD, Rosette	9	9		9					9	2	8
IP08_2_202	78°15.241	143°00.746	16.09.2008	13.28	CTD, Rosette	10	10									
IP08_2_203	78°30.106	143°00.045	16.09.2008	15.48	CTD											
IP08_2_204	78°45.376	142°59.249	16.09.2008	18.20	CTD, Rosette	11	11									
IP08_2_205	77°29.972	143°00.600	17.09.2008	04.38	CTD, Rosette, Boxcorer, Net	9	9		9	2	1		1	9	2	
IP08_2_206	76°59.957	142°59.450	17.09.2008	09.26	CTD, Rosette, Boxcorer, Net	7	7		7	2	1		1	7	2	4
IP08_2_207	76°30.221	143°01.131	17.09.2008	14.14	CTD, Rosette, Boxcorer, Net	6	6	2	6	2	1	1	1	6	2	5
IP08_2_208	75°59.915	143°00.161	17.09.2008	18.30	CTD, Rosette, Boxcorer, Net	5	5	2	5	1	1	1	1	5	2	
IP08_2_209	76°00.166	146°00.950	18.09.2008	00.06	CTD, Rosette, Boxcorer, Net	7	7	2	7	2	1		1	7	2	4
IP08_2_210	74°29.966	147°59.942	18.09.2008	12.34	CTD, Rosette, Boxcorer, Net	3	3	2	3	1	1		1	3	2	
IP08_2_211	73°59.993	147°59.941	18.09.2008	16.26	CTD, Rosette, Boxcorer, Net	3	3	2	3	1	1		1	3	2	
IP08_2_212	73°30.000	148°00.000	18.09.2008	21.00	CTD, Rosette, Boxcorer, Net	3	3	2	3	1	1		1	3	2	2
IP08_2_213	72°59.926	147°59.894	19.09.2008	01.27	CTD, Rosette, Boxcorer, Net	2	2	2	2	1	1		1	2	2	1
IP08_2_214	72°59.954	145°59.601	19.09.2008	05.52	CTD, Rosette	3	3	2							2	2
IP08_2_215	73°00.035	143°59.773	19.09.2008	10.01	CTD, Rosette, Boxcorer, Net	3	3	2	3	1	1		1	3	2	2
IP08_2_216	73°00.093	142°00.255	19.09.2008	15.07	CTD, Rosette, Boxcorer, Net	4	4	2	4	1	1		1	4	2	
IP08_2_217	73°16.011	140°02.049	19.09.2008	19.42	CTD											
IP08_2_218	73°06.000	140°20.001	19.09.2008	21.28	CTD, Rosette, Boxcorer, Net	4	4	2	4	1	1		1	4	2	3
IP08_2_219	72°53.986	140°44.091	19.09.2008	23.36	CTD											
IP08_2_220	72°45.089	139°07.008	20.09.2008	02.59	CTD, Rosette, Boxcorer, Net	3	3	2	3	1	1		1	3	2	2
IP08_2_221	72°35.035	137°29.524	20.09.2008	07.14	CTD, Rosette, Boxcorer, Net	5	5	2	5	2	1		1	5	2	3
IP08_2_222	72°24.983	135°54.828	20.09.2008	11.25	CTD, Rosette, Boxcorer, Net	5	5	2	5	2	1		1	5	2	3
IP08_2_223	72°14.974	134°19.866	20.09.2008	15.46	CTD, Rosette, Boxcorer, Net	5	5	2	5	2	1		1	5	2	3
IP08_2_224	72°02.996	132°45.010	20.09.2008	20.24	CTD, Rosette, Net	4	4	2	4	2	1			4	2	3

- Station list TRANSDRIFT XIV

Station #	Station type	Start of station [Latitude]	Start of station [Longitude]	End of station [Latitude]	End of station [Longitude]	Depth	Time start [UTC]	Time end [UTC]	Dissolved oxygen [amount]	Nutrients for on-board processing [amount]	Nutrients for AutoAnalyzer in OSL [amount]	CDOM 1 [amount]	CDOM 2 [amount]	Chlorophyll *a* [amount]	Chlorophyll *a* [depths]	Zooplankton	Phytoplankton	Meiobenthos	Macrobenthos	δ[18]O nominal depth [m]	SPM nominal depth [m]
YS09-01	CTD/Rosette cast	N74°19.8912'	E132°0.82572'	N74°19.97778'	E131°41.19492'	14.9	9.9.09 7:00	9.9.09 9:30	4	4	4	2	2	4	1,5,10,15	1	1	1		1,5,10,15	1,5,10,15
YS09-02	CTD/Rosette cast	N74°19.83282'	E130°59.94558'	N74°19.59618'	E130°59.12328'	23.9	9.9.09 10:50	9.9.09 11:45			6			5	1,5,10,15, 20					1,5,10,20	
YS09-03	CTD/Rosette cast	N74°19.79808'	E130°0.3885'	N74°18.7932'	E130°5.16978'	19.6	9.9.09 13:15	9.9.09 14:30	5	5	5	2	2	4	1,5,10,15	2	1	1		1,5,10,15, 18	1,5,10,15,18
YS09-04	CTD/Rosette cast	N74°19.8654'	E129°1.01358'	N74°19.5171'	E128°49.69938'	17.8	9.9.09 16:30	9.9.09 17:35			4			5	1,5,10,15, 17					1,5,10,15, 17	
YS09-05	CTD/Rosette cast	N74°19.20678'	E128°12.67788'	N74°19.60368'	E128°6.80592'	32.6	9.9.09 19:15	9.9.09 22:20	7	7	7	2	2	7	1,5,10,15, 20,25,30	2	1				1,5,10,15, 20,25,30
YS09-06	CTD/Rosette cast	N74°20.03802'	E127°1.06182'	N74°20.25438'	E126°58.78032'	33.3	10.9.09 0:30	10.9.09 1:10			6			7	1,5,10,15, 20,25,29						
YS09-07	CTD/Rosette cast	N74°19.56588'	E126°2.27082'	N74°1.932222'	E126°4.0737'	30.5	10.9.09 2:45	10.9.09 3:55	7	7	7	2	2	7	1,5,10,15, 20,25,29	1	1			1,5,10,15, 20,25,29	1,5,15,20, 25,29
YS09-08	CTD/Rosette cast	N74°19.67682'	E125°0.6669'	N74°0.0193926'	E125°1.67502'	23.5	10.9.09 6:00	10.9.09 7:00			5			5	1,5,10,15, 20					1,5,10,15, 20	
YS09-09	CTD/Rosette cast	N74°19.9728'	E123°59.52078'	N74°1.984458'	E123°59.29758'	17.2	10.9.09 8:45	10.9.09 9:35	4	4	4	2	2	4	1,5,10,13	1	1	1			1,5,10,15
YS09-10	CTD/Rosette cast	N74°19.98612'	E122°59.8869'	N74°2.004762'	E122°59.60862'	12.8	10.9.09 11:15	10.9.09 11:45	3	3	3	2	2	3	1,5,9	1				1,5,9	1,5,9
YS09-11	Mooring recovery (ANABAR)	N74°19.8624'	E128°0.3852'	N74°2.160612'	E127°49.90488'	33	0.1.00 21:00	10.9.09 21:40													
YS09-12	CTD/Rosette cast	N74°25.39692'	E127°25.21068'	N74°2.57958'	E127°23.0112'	34	10.9.09 22:35	10.9.09 23:00			7									1,5,10,15, 20,25,30, 33	1,5,10,15, 20,25,30,33
YS09-13	CTD/Rosette cast	N74°29.87808'	E126°53.55072'	N74°3.016818'	E126°53.90532'	23.8	11.9.09 0:00	11.9.09 0:40			4										
YS09-14	CTD/Rosette cast	N74°34.4592'	E126°19.8144'	N74°3.4701'	E126°18.39018'	32.5	11.9.09 2:00	11.9.09 3:00	8	8	8	2	2	8	1,5,10,15, 20,25,30, 31	2	1	1	2	1,5,10,15, 20,25,30, 31	1,5,10,15, 20,25,30,31
YS09-15	CTD/Rosette cast	N74°38.93898'	E125°47.85738'	N74°3.895128'	E125°47.88432'	38	11.9.09 4:05	11.9.09 4:35			8										
YS09-16	Mooring recovery (KHATANGA)	N74°42.8646'	E125°17.343'	N74°4.297308'	E125°16.67472'	42.9	11.9.09 5:50	11.9.09 7:15	8	8	8	2	2	8	1,5,10,15, 20,25,30, 39	2	1	1			1,5,10,15, 20,25,30,39
YS09-17	CTD/Rosette cast	N74°48.12228'	E125°59.8533'	N74°4.831212'	E125°59.3964'	23.7	11.9.09 9:10	11.9.09 9:50			6	2	2	6	1,5,10,15, 20,22					1,5,10,15, 20,22	1,5,10,15, 20,22

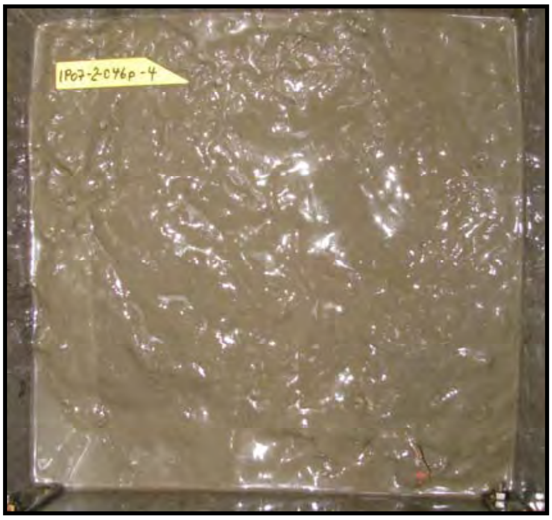
Station #	Station type	Start of station [Latitude]	Start of station [Longitude]	End of station [Latitude]	End of station [Longitude]	Depth	Time start [UTC]	Time end [UTC]	Dissolved oxygen [amount]	Nutrients for on-board processing [amount]	Nutrients for AutoAnalyzer in OSL [amount]	CDOM 1 [amount]	CDOM 2 [amount]	Chlorophyll *a* [amount]	Chlorophyll *a* [depths]	Zooplankton	Phytoplankton	Meiobenthos	Macrobenthos	$\delta^{18}O$ nominal depth [m]	SPM nominal depth [m]
YS09-18	CTD/Rosette cast	N75°6.03498'	E125°59.706'	N75°0.660102'	E125°58.98972'	33.1	11.9.09 11:35	11.9.09 12:35	7	7	7	2	2	7	1,5,10,15, 20,25,29	2	1	1	1	1,5,10,15, 20,25,29	1,5,10,15, 20,25,29
YS09-19	CTD/Rosette cast	N75°24.04968'	E125°59.84892'	N75°2.57049'	E125°59.8926'	38.1	11.9.09 14:20	11.9.09 14:55			8	2	2	8	1,5,10,15, 20,25,30, 34					1,5,10,15, 20,25,30, 34	1,5,10,15, 20,25,30,34
YS09-20	CTD/Rosette cast	N75°42.0732'	E125°59.4576'	N75°4.245438'	E125°56.77908'	42.3	11.9.09 16:35	11.9.09 17:50	8	8	8	2	2	7	1,5,10,15, 20,25,30	2	1	1	2	1,5,10,15, 20,25,30, 38	1,5,10,15, 20,25,30
YS09-21	CTD/Rosette cast	N76°0.14988'	E125°58.97598'	N76°0.034392'	E125°56.48652'	44.9	11.9.09 19:45	11.9.09 20:25			8	2	2	9	1,5,10,15, 20,25,30, 40,45					1,5,10,15, 20,25,30, 40	1,5,10,15, 20,25,30,40
YS09-22	CTD/Rosette cast	N76°18.1293'	E125°59.32332'	N76°1.80663'	E125°53.21898'	49.9	11.9.09 22:05	11.9.09 23:20	9	9	9	2	2	8	1,5,10,15, 20,25,30, 40	2	1			1,5,10,15, 20,25,30, 40,46	1,5,10,15, 20,25,30,40
YS09-23	Mooring recovery (OSL2C)	N76°34.239'	E126°5.0958'	N76°4.735872'	E125°58.64832'	52	12.9.09 1:00	12.9.09 3:30				2	2	9	1,5,10,15, 20,25,30, 40,48					1,5,10,15, 20,25,30, 40,48	1,5,10,15, 20,25,30,40, 48
YS09-24	CTD/Rosette cast	N76°48.20718'	E125°52.58778'	N76°4.83027'	E125°49.6218'	66.6	12.9.09 5:20	12.9.09 6:10	9	9	9	2	2	7	1,5,10,15, 20,25,30, 40	2	1			1,5,10,15, 20,25,30, 40,50	5,10,15,20, 25,30,40
YS09-25	Mooring recovery (OSL3)	N77°59.2548'	E143°0.534'	N77°5.857422'	E142°57.7689'	50.1	13.9.09 5:00	13.9.09 11:20	9	9	9			9	1,5,10,15, 20,25,30, 40,47	1	1	1	2	1,5,10,15, 20,25,30, 40,47	1,5,10,15, 20,25,30,40, 47
YS09-41	CTD/Rosette cast	N77°50.11122'	E139°59.763'	N77°5.006838'	E139°59.71518'	46.5	13.9.09 14:45	13.9.09 15:05				2	2	9	1,5,10,15, 20,25,30, 40,43	2					
YS09-42	CTD/Rosette cast	N77°29.8845'	E134°59.3502'	N77°2.953362'	E134°58.1616'	53	13.9.09 21:45	13.9.09 22:50	9	9	9	2	2	9	1,5,10,15, 20,25,30, 40,50	2				1,5,10,15, 20,25,30, 40,50	1,5,10,15, 20,25,30,40, 50
YS09-43	CTD/Rosette cast	N76°59.95092'	E129°59.86662'	N76°5.96493'	E129°58.4343'	60.5	14.9.09 5:20	14.9.09 6:10		9		2	2	9	1,5,10,15, 20,25,30, 40,50	2					
YS09-26	Mooring deployment (OSL2D)	N76°34.1964'	E126°4.9458'	N76°3.408918'	E126°3.17532'	53	14.9.09 12:00	14.9.09 13:30													
YS09-27	Mooring deployment (OSL4)	skipped	skipped	skipped	skipped		skipped														
YS09-28	CTD/Rosette cast	N77°16.1808'	E114°21.9267'	N77°1.653672'	E114°16.83048'	65.8	15.9.09 4:15	15.9.09 5:40	10	10	10	2	2	10	1,5,10,15, 20,25,30, 40,50,60	2	1	1		1,5,10,15, 20,25,30, 40,50,60	1,5,10,15, 25,30,40,50, 60

Station #	Station type	Start of station [Latitude]	Start of station [Longitude]	End of station [Latitude]	End of station [Longitude]	Depth	Time start [UTC]	Time end [UTC]	Dissolved oxygen [amount]	Nutrients for on-board processing [amount]	Nutrients for AutoAnalyzer in OSL [amount]	CDOM 1 [amount]	CDOM 2 [amount]	Chlorophyll a [amount]	Chlorophyll a [depths]	Zooplankton	Phytoplankton	Meiobenthos	Macrobenthos	δ18O nominal depth [m]	SPM nominal depth [m]
YS09-29	CTD/Rosette cast	N76°50.0964'	E116°41.00652'	N76°4.955628'	E116°39.51498'	42.8	15.9.09 9:30	15.9.09 10:30		8	8			8	1,5,10,15, 20,25,30, 40	2				1,5,10,15, 20,25,30, 40	1,5,10,15, 20,25,30,40
YS09-30	CTD/Rosette cast	N76°30.49692'	E118°16.57632'	N76°2.979162'	E118°15.0777'	47.7	15.9.09 13:15	15.9.09 14:15	8	8	8	2	2	8	1,5,10,15, 20,25,30, 46	2	1	1		1,5,10,15, 20,25,30, 46	5,10,15,20, 25,30,46
YS09-31	CTD/Rosette cast	N76°10.19988'	E119°51.93672'	N76°0.955908'	E119°51.11568'	58.5	15.9.09 17:00	15.9.09 18:10	8	9	9			8	1,5,15,20, 25,30,40, 54	2				1,5,10,15, 20,25,30, 40,54	1,5,15,20, 25,30,40,54
YS09-32	CTD/Rosette cast	N75°49.2402'	E121°20.26692'	N75°4.884372'	E121°20.22018'	62.3	15.9.09 20:45	15.9.09 21:40	10	10	10	2	2	10	1,5,10,15, 20,25,30, 40,50,59	2	1			1,5,10,15, 20,25,30, 40,50,59	1,5,10,20, 25,30,40,50, 59
YS09-33	CTD/Rosette cast	N75°27.47418'	E122°40.99362'	N75°2.51976'	E122°48.63348'	49.9	16.9.09 0:30	16.9.09 1:40	9	6	6			6	1,5,10,30, 40,46	2				1,5,10,15, 20,25,30, 40,46	1,5,10,30, 40,46
YS09-34	CTD/Rosette cast	N75°5.93472'	E124°2.1357'	N75°0.574092'	E123°58.79928'	48	16.9.09 4:20	16.9.09 5:10	7	7	7	2	2	7	1,5,10,15, 30,40,44					1,5,10,15, 20,25,30, 40,44	1,5,10,15, 30,40,44
YS09-35	Mooring deployment (KHATANGA)	N74°42.942'	E125°16.9464'	N74°43.33908'	E125°17.55162'	43	16.9.09 8:20	16.9.09 10:25	6	6	6			6	10,15,20, 25,30,39					10,15,20, 25,30,39	10,15,20,25, 30,39
YS09-36	CTD/Rosette cast	N74°38.98068'	E125°47.88978'	N74°3.904812'	E125°48.62928'	38	16.9.09 11:35	16.9.09 12:20													
YS09-37	CTD/Rosette cast	N74°34.242'	E126°20.01528'	N74°3.405732'	E126°19.96458'	32.7	16.9.09 13:15	16.9.09 13:35													
YS09-38	CTD/Rosette cast	N74°29.83332'	E126°53.22168'	N74°2.962608'	E126°52.43742'	24.4	16.9.09 14:35	16.9.09 14:50													
YS09-39	CTD/Rosette cast	N74°25.4016'	E127°24.8718'	N74°2.542128'	E127°24.37242'	33.9	16.9.09 15:45	16.9.09 16:00													
YS09-40	Mooring deployment (ANABAR)	N74°19.9176'	E128°0.162'	N74°1.979622'	E128°1.2207'	32.8	16.9.09 17:00	16.9.09 18:20													

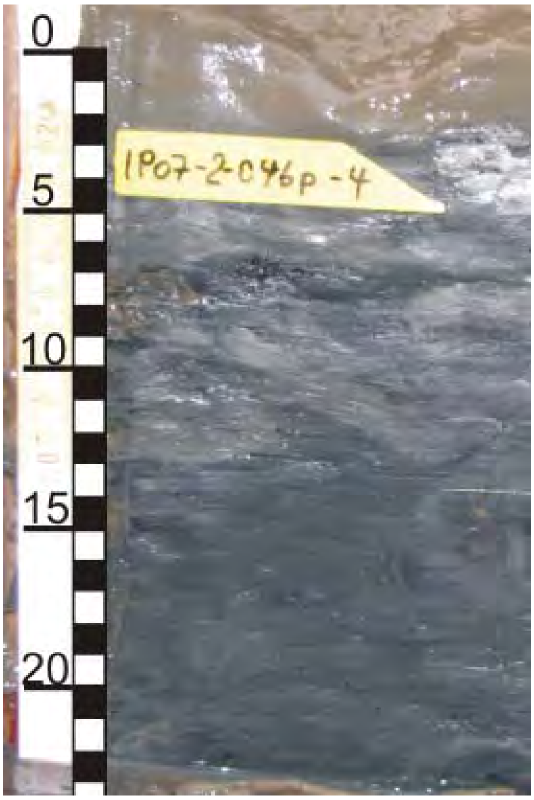
Box Core 1	**IP07_2_046p_4**

Date: 30.08.07
Time (GMT): 10.33 am

Latitude: 74°50,279' N
Longitude: 128°55,555' E
Water Depth: 37,5 m
Core´s Length: 23 cm



Temperature: right upper corner: -1,44°C
left upper corner: -1,54°C
right lower corner: -1,58°C
center: -1,66°C (7 cm sensor)
Tubes taken: 1

Profile Image	Core Description	Samples/ Measurements
	<u>0-4 cm Surface</u> olive brown, silty clay, Opheura present <u>4-13 cm</u> black greenish gray, clay <u>13-23 cm</u> dark grey, clay, H_2S- smell	

Additional Information: -Gammarus found at 10 cm
-no pore water samples taken

Box Core 2	**IP07_2_049p_4**

Date: 30.08.07
Time (GMT): 15.56

Latitude: 75°21,219' N
Longitude: 129°00,205' E
Water Depth: 38,5 m
Core´s Length: 28 cm

Temperature: center= -1,69°C (15cm sensor)
Tubes taken: 1

Profile Image	Core Description	Samples/ Measurements
	<u>0-1 cm Surface</u> lightolive brown, finesandy silt, Opheura present (different sizes, small most, N>10), oxic <u>1-28 cm</u> grey,clayey finesandy silt, laminated with dark lenses <u>17-20 cm</u> no silty finesandy lenses present! <u>20 cm</u> Shell fractures, complete shells (Mahoma)	<u>Surface</u> MeioBenthos <u>0-2 cm</u> Sample for Pore Water Analysis <u>10 cm</u> Sample for Pore Water Analysis <u>10 cm Depth</u> Temp.= -1,66°C <u>20 cm Depth</u> Temp.= -1,71°C <u>20 cm</u> Sample for Pore Water Analysis

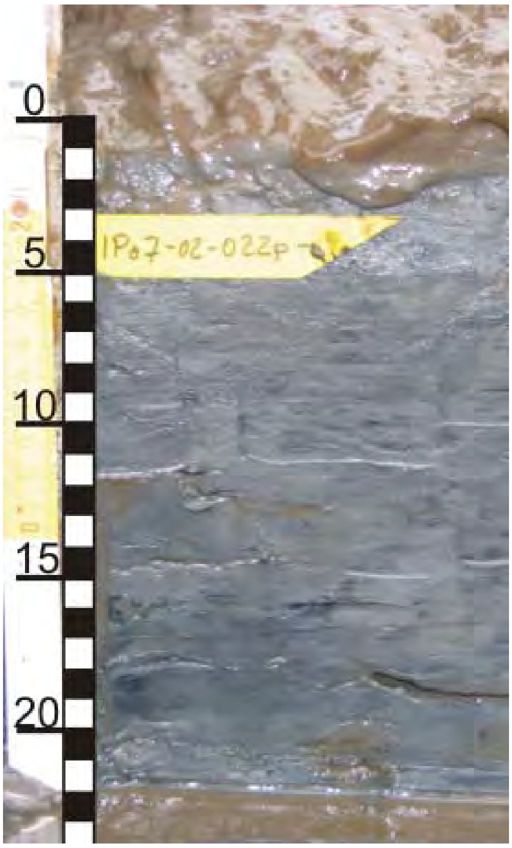
Additional Information: -

Box Core 3	**IP07_2_022p_4**

Date: 01.09.07
Time (GMT): 9.33 am

Latitude: 75°19,341' N
Longitude: 126°01,818' E
Water Depth: 39 m
Core´s Length: 22 cm

Temperature: center: -1,75°C
(15 cm sensor)
Tubes taken: 1

Profile Image	Core Description	Samples/ Measurements
	0-3 cm Surface Light brown-green, finesandy silty clay 3-20 cm finesandy clay with silty components Change of black and grey layers, black part decrease with depth	Surface MeioBenthos 0-2 cm Sample for Pore Water Analysis 10 cm Sample for Pore Water Analysis 20 cm Sample for Pore Water Analysis

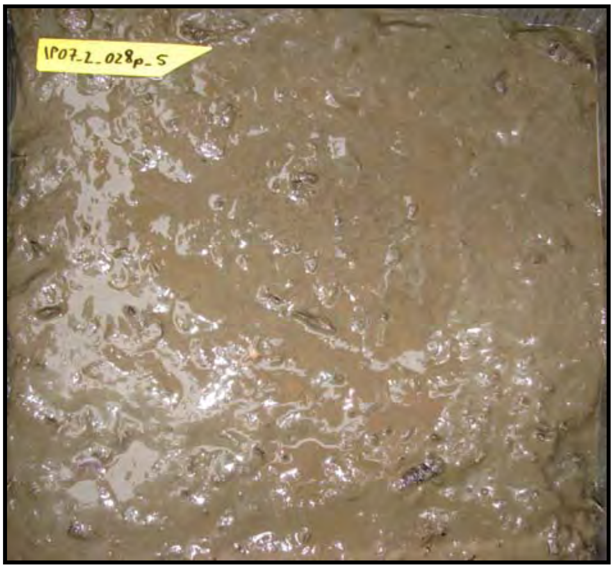
Additional Information: -

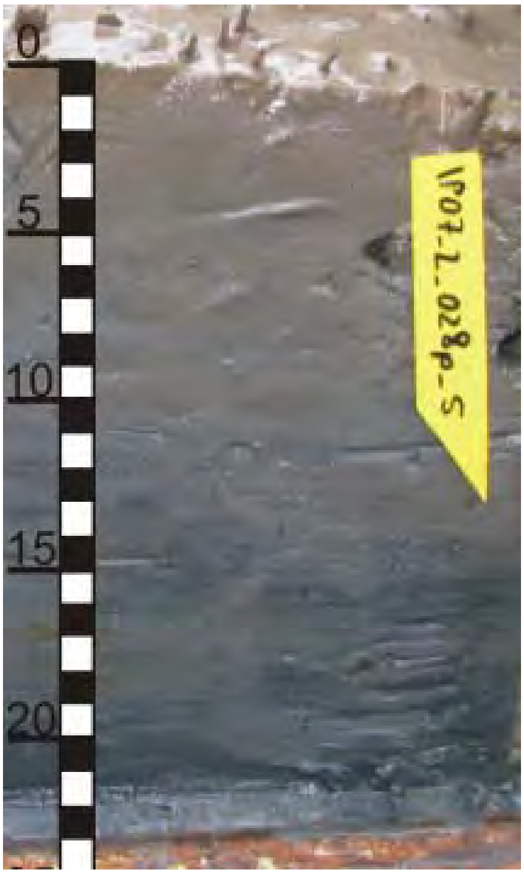
Box Core 4	**IP07_2_028p_5**

Date: 01.09.07
Time (GMT): 22.11

Latitude: 74°18,934’ N
Longitude: 125°52,888’ E
Water Depth: 31 m
Core´s Length: 22 cm

Temperature: center: -1,11°C (15 cm sensor)
Tubes taken: 1



Profile Image	Core Description	Samples/ Measurements
	<u>0-9 cm</u> Change of olilve and brownish color, silty clayey Finesand, Polychaeta, Gammarus, Bryozoa and small Opheura present <u>9-22 cm</u> dark grey- black, silty clayey Finesand	<u>Surface</u> MeioBenthos <u>0-2 cm</u> Sample for Pore Water Analysis <u>10 cm</u> Sample for Pore Water Analysis <u>20 cm</u> Sample for Pore Water Analysis

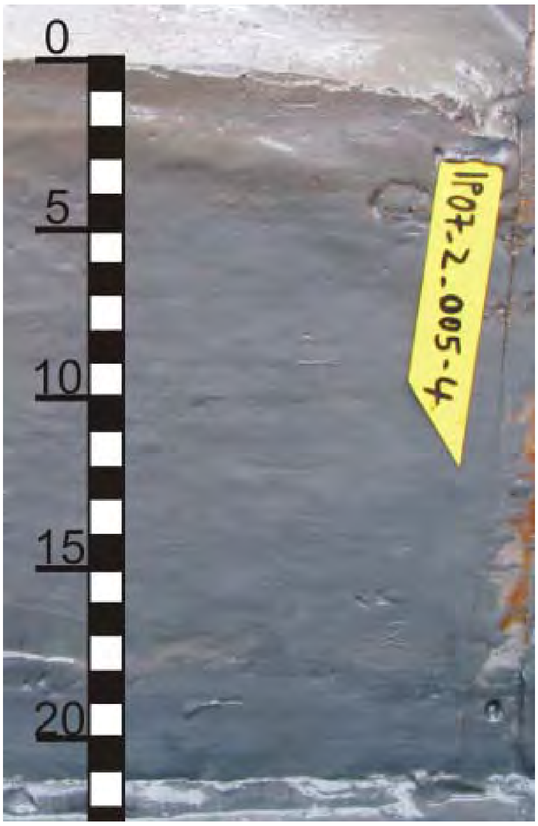
Additional Information: -

Box Core 5	**IP07_2_005_4**

Date: 07.09.07
Time (GMT): 0.53 am

Latitude: 75°58,787' N
Longitude: 143°00,852' E
Water Depth: 22,8 m
Core´s Length: 23 cm

Temperature: center: 1,43°C (15 cm sensor)
Tubes taken: 2 (A, B)

Profile Image	Core Description	Samples/ Measurements
	<u>0-1 cm Surface</u> sandy with clayey and coarse sandy components, Mud pellets present, Opheura and Polychaeta present <u>1-23 cm</u> Change from olive greyish brown to black-brown, silty clay, laminated	<u>Surface</u> MeioBenthos Sample of 2 shells (IP07_2_005) <u>0-2 cm</u> Sample for Pore Water Analysis <u>4 cm</u> Sample of concretion (IP07_2_005) <u>9 cm</u> Temperature 1,41°C <u>10 cm</u> Sample for Pore Water Analysis <u>20 cm</u> Sample for Pore Water Analysis

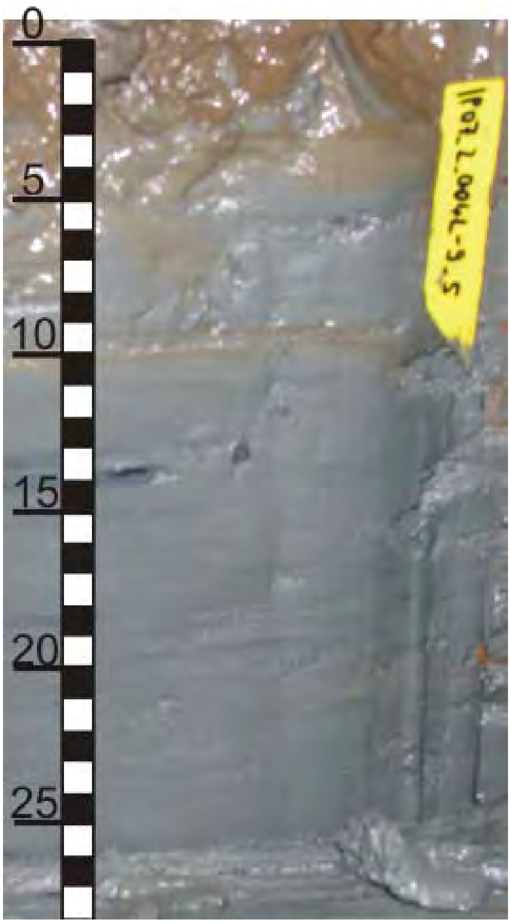
Additional Information: Core marked as 4. activity; really, in protokoll it was the fifth activity of device

Box Core 6	**IP07_2_004L-9_5**

Date: 11.09.07
Time (GMT): 12.10

Latitude: 76°43,809' N
Longitude: 125°54,730' E
Water Depth: 62 m
Core´s Length: 26 cm

Temperature: center: -1,61° (15 cm sensor)
Tubes taken: 2 (A, B)

Profile Image	Core Description	Samples/ Measurements
	<u>0-6 cm</u> grey- brown, silty clayey, Polychaeta present <u>10-29 cm</u> Laminated with rich layers of Polychaets (14 cm), lenses with high finesand-part present (more water saturated, softer)	<u>Surface</u> MeioBenthos <u>0-2 cm</u> Sample for Pore Water Analysis <u>14 cm</u> Sample for Pore Water Analysis <u>24 cm</u> Sample for Pore Water Analysis

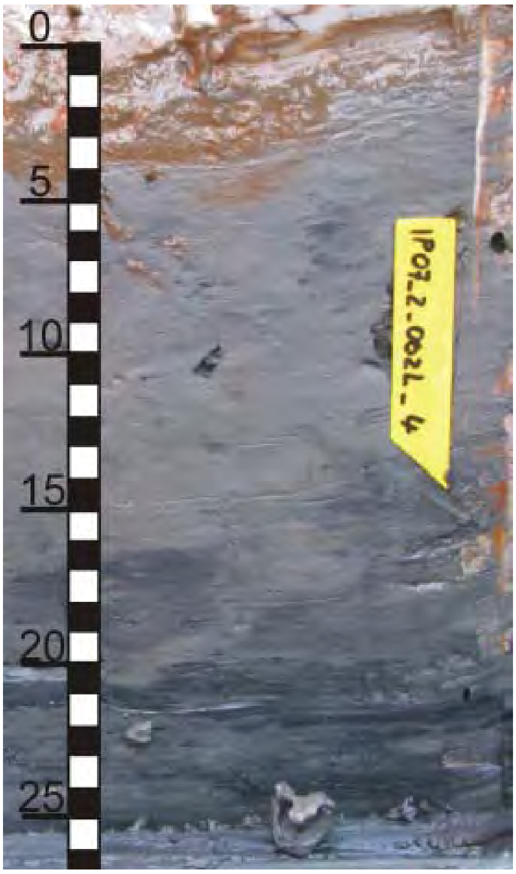
Additional Information: Station of the mooring OSL 2a (24 h measurements)
A-Tube: Sediment got 5-7 cm compressed
B-Tube: Sediment got 2-3 cm compressed
no plain surface

Box Core 7	**IP07_2_002L_4**

Date: 12.09.07
Time (GMT): 3.50 am

Latitude: 76°19,378’ N
Longitude: 125°57,054’ E
Water Depth: 49 m
Core´s Length: 26 cm

Temperature: center: -1,73°C
(15 cm sensor)
Tubes taken: 2 (A, B)

Profile Image	Core Description	Samples/ Measurements
	<u>0-1 cm Surface</u> Brown- grey, finesandy, clayey silt, Opheura present, Polycheata (Tubes, concreted) <u>1-15 cm</u> Light grey, silty clay, lenses of black silty clay <u>15-26 cm</u> lenses of black silty clay decrease (softer, more plastically)	<u>Surface</u> MeioBenthos <u>Surface</u> Polychaeta (IP07_2_002L) <u>0-2 cm</u> Sample for Pore Water Analysis <u>10 cm</u> Sample for Pore Water Analysis <u>20 cm</u> Sample for Pore Water Analysis

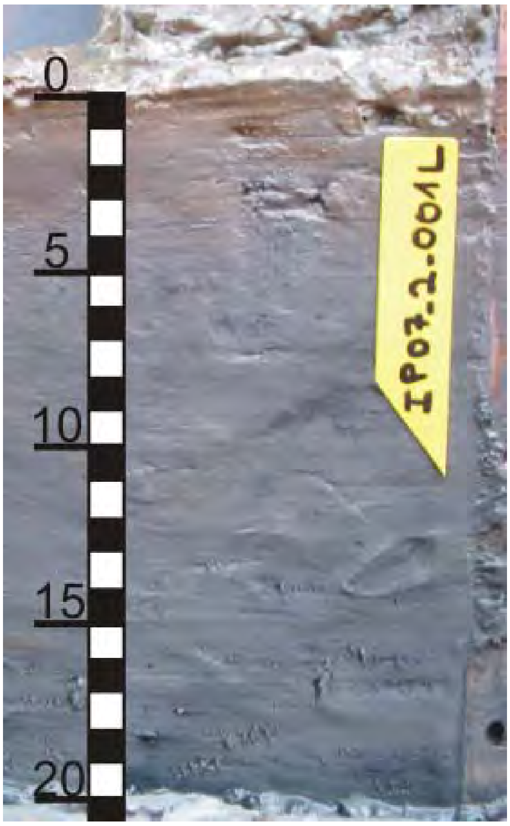
Additional Information: A-Tube: hardly compressed in length
B-Tube: compressed to the core length of ~21 cm

Box Core 8	**IP07_2_001L_4**

Date: 12.09.07
Time (GMT): 8.36 am

Latitude: 75°49,326' N
Longitude: 125°53,987' E
Water Depth: 44 m
Core´s Length: 20 cm

Temperature: center: -1,77°C (15 cm sensor)
Tubes taken: 2 (A,B)

Profile Image	Core Description	Samples/ Measurements
	<u>0-2 cm Surface</u> grey-brown, silty clay, Opheura, Bivalvia (Portlandia *arctica),* Sibtum *culida* and Polychaeta present <u>2-20 cm</u> dark grey to black, silty-clayey, laminated <u>5-10cm</u> Mud pellets	<u>Surface</u> MeioBenthos <u>0-2 cm</u> Sample for pore water analysis <u>8-10 cm</u> Sample for pore water analysis <u>18-20 cm</u> Sample for pore water analysis

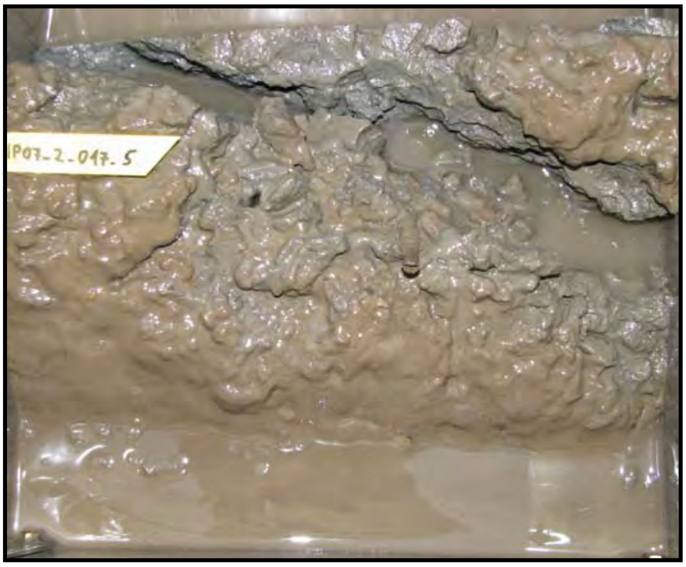
Additional Information: -

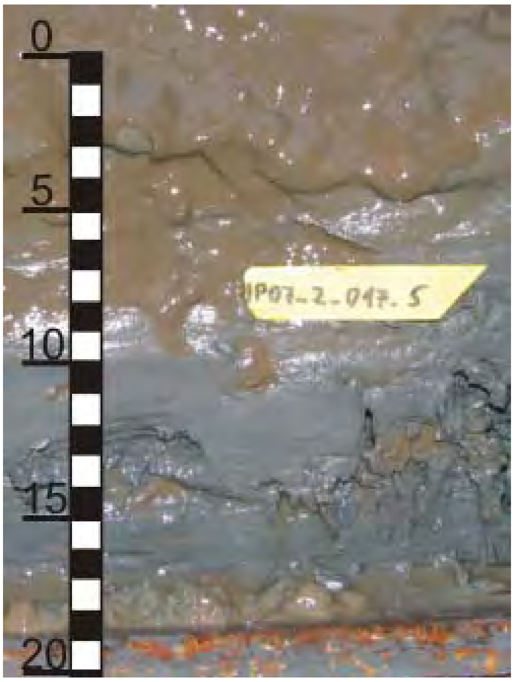
Box Core 9	**IP07_2_017_5**

Date: 16.09.07
Time (GMT): 9.26 am

Latitude: 74°27,325' N
Longitude: 139°43,390' E
Water Depth: 28,5 m
Core´s Length: 18 cm

Temperature: center: -0,91°C (15 cm sensor)
Tubes taken: 1



Profile Image	Core Description	Samples/ Measurements
	Surface greenish grey, silty clay with finesandy components, Polychaeta and shells present	Surface MeioBenthos

Additional Information: Box Core very destroyed, no profile description possible, no samples taken for pore water analysis
Core Tube wrong marked: length=25 cm instead of 18 cm !!!

Box Core 10 **IP07_2_024_3**

Date: 17.09.07
Time (GMT): 11.08 am

Latitude: 72°25,303' N
Longitude: 135°57,263' E
Water Depth: 22,5 m
Core´s Length: 24 cm

Temperature: center: -0,75°C (15 cm sensor)
Tubes taken: 2 (A, B)

<table>
<tr><th>Profile Image</th><th>Core Description</th><th>Samples/ Measurements</th></tr>
<tr><td>
</td><td><u>0-2 cm Surface</u>
greenish grey, sandy silty, Polychaeta, Isopods (Saduria sibirica) and Chryctazoa (Meeresassel) present
<u>2-24 cm</u>
grey and black in change, clay, water saturation not equal, laminated</td><td><u>0-2 cm</u>
MeioBenthos
<u>0-1 cm</u>
Sample for pore water analysis

<u>10 cm</u>
Sample for pore water analysis

<u>20 cm</u>
Sample for pore water analysis</td></tr>
</table>

Additional Information: -

Box Core 11	**IP07_2_006_6**

Date: 07.09.07
Time (GMT): 5.47 am

Latitude: 76°29,230' N
Longitude: 142°58,848' E
Water Depth: 28,5 m
Core´s Length: -

Temperature: -
Tubes taken: -

Profile Image	Core Description	Samples/ Measurements
No Photo were taken	<u>Surface</u> grey-brown, finesandy clayey silt, Polychaeta, Opheura and Saduria *sadini* present	<u>Surface</u> MeioBenthos No further, see additional information below

Additional Information: box core partly destroyed, sample is not plain
no core tubes were taken
no further measurements and samples