

Cruise report

Lance, September 11 to October 2, 2000

Introduction

The investigations during the Lance cruise in September 2000 were aimed at studies regarding the ventilation of the deeper parts of the Greenland Sea. This studies are part of the ARKTIEF program funded by the the german ministry of education and science (BMBF, Förderkennzeichen 03PL030C). The main goal of this study is to determine the importance of flows, not along but across the continental slope for the ventilation of the near bottom and deep waters in the Greenland sea. The hypothesis is that these flows follow channels which cut across the continental slope and are forced by buoyancy forces due to sediments. Another energy force for this flows could be the deep boundary current flowing along the continental slope. One mooring had already been placed in one such channel in 1999, and for this cruise it was planned to put more moorings along this channel and another, still unknown channel. These moorings will measure current speed and direction, temperature, salinity and suspended matter. On some moorings sediment traps will monitor the amount and composition of falling particles. The recovery of these mooring is planned for september 2001. It was planned to conduct CTD surveys along and across the channels. But due to a cable breakage at the beginning of the cruise only shallow CTD stations till about 1500m were possible for the rest of the cruise. The CTD work were therefore aimed at the capture of the shallower western boundary current region, an area where investigations were planned for 2001 within the Sonderforschungsbereich 512, Project C4.

Participants

Name		Institute
Dr. J. Holfort	scientist, oceanography, cruise leader	IfM-Hamburg
Dr. E. Bauerfeind	scientist, biology	IOW
U. Drübbisch	technician, moorings	IfM-Hamburg
M. Monsses	technician, moorings	AWI
M. Bergenthal	technician, profiling CTD	Uni. Bremen
M. Brichta	scientist, biology	AWI
G. Wiczorek	student, oceanography	IfM-Hamburg
I. Frambach	student, oceanography	IfM-Hamburg
K. Kirchner	student, oceanography	IfM-Hamburg
F. Hacker	student, oceanography	IfM-Hamburg
S. Hüttemann	student, oceanography	IfM-Hamburg
O. Timm	student, oceanography	IfM-Hamburg
H. Rohr	student, oceanography	AWI

Cruise summary

All participants, except H. Rohr who was on board from a previous cruise, left Hamburg on september 11 and arrived in Longyearbyen on september 12. The next morning the cargo was unloaded and the laboratories were equipped, etc. Lance left port at 14:30, but just after leaving a ruder problem was encountered, so the ship had to be anchored after a trip of about 500m. A technician from land could identify and resolve the problem so that at 20:00 o'clock the cruise finally started. The way to the research area, where two tests of the CTD system were conducted, took 2 days. The AWI mooring 419-1 was recovered during the early morning of september 16. A deep CTD cast was conducted afterwards. On the way up, after closing several bottles and about 500m above the deepest point, the cable broke near the surface. Therefore the CTD with water sampler and about 2700m of cable were lost. A spare CTD was attached to the remaining of the cable. In contrast to the lost CTD, the spare had no oxygen and transmissometer, the bottle sampler had only 12 compared to 24 bottles and no thermometers could be attached to the bottles. The remaining cable was not long enough for deep profiles till the bottom, so for the rest of the cruise the CTD casts were conducted only to 1500 dbar. The scientific aim of the CTD work therefore changed from the flow in deep channels to the water mass characteristics of the East Greenland current. Water samples for the analysis of suspended matter were taken on some CTD stations.

During the following days, during daytime and weather permitting, three full depth moorings and three short moorings were deployed in the channel along about $74^{\circ}15'N$. Between mooring deployments CTD stations were taken along a section at $74^{\circ}30'N$ and at $74^{\circ}N$, both until the ice edge. Also some sounding lines were taken using a simple echo sounder, the only output being on paper. It was expected that a second channel would be found on this sounding lines, but none was found. From an hydrosweep survey of the main channel in Summer, it seemed that the channel does not continue to depths shallower than about 2800m. This hydrosweep survey stopped at about $74^{\circ}N$, $12^{\circ}50'W$ due to ice conditions. The sounding lines acquired on Lance showed no continuation into shallower water to the west and north of this position. But on one sounding line it appears as if the channel continues, although not so pronounced, to the southwest.

Three of this moorings were grouped in a very small scale array (a triangle with sides about 5 km long). Included in this moorings were also sediment traps and an experimental profiling CTD. The short moorings were supposed to be uphill of this array till about 2000m depth and a fourth being positioned in a second channel. Because of the topography encountered, plans were changed and three short moorings were positioned along the channel uphill till about 2800m depth. The technical specifications of the fourth short mooring did not allow a deployment deeper than 2000 dbar, so this mooring was deployed a little bit north of the shallowest moorings in the channel on the continental slope at about 2000m water depth. With this setup, it could be possible to correlate changes in the deep western boundary current flowing southward with episodic flows through the channel. Mechanisms of such possible correlation are studied in another project within the ARKTIEF program.

After this deep moorings a experimental mooring were put out on the continental shelf at a water depth of about 300m. This meant to go into quite ice covered regions. The mooring was specifically designed to measure the near surface temperature and salinity in such regions without being crushed by drifting ice. The upper part of the mooring is a plastic tube, about 50m long. Incorporated in this tube is the flotation and the temperature and salinity sensors. Most of the flotation is in the lower part of this tube. It is expected that drifting ice will tilt the whole tube and therefore the ice will not crush the instruments. It was not an easy task to

assemble such a long tube on board, but Lance has a quite long deck and so assembly and also deployment went on smoothly.

After the finish of the mooring work, the 74°N CTD section was prolonged to 5°W. From this point another CTD section was made in northeasterly direction until heavy ice on the shelf was encountered. Some ice probes were taken to estimate the possible composition (and amount) of sediments that are released into the water at melting. This point concluded the scientific work and Lance headed back to Longyearbyen, arriving on Saturday, September 30.

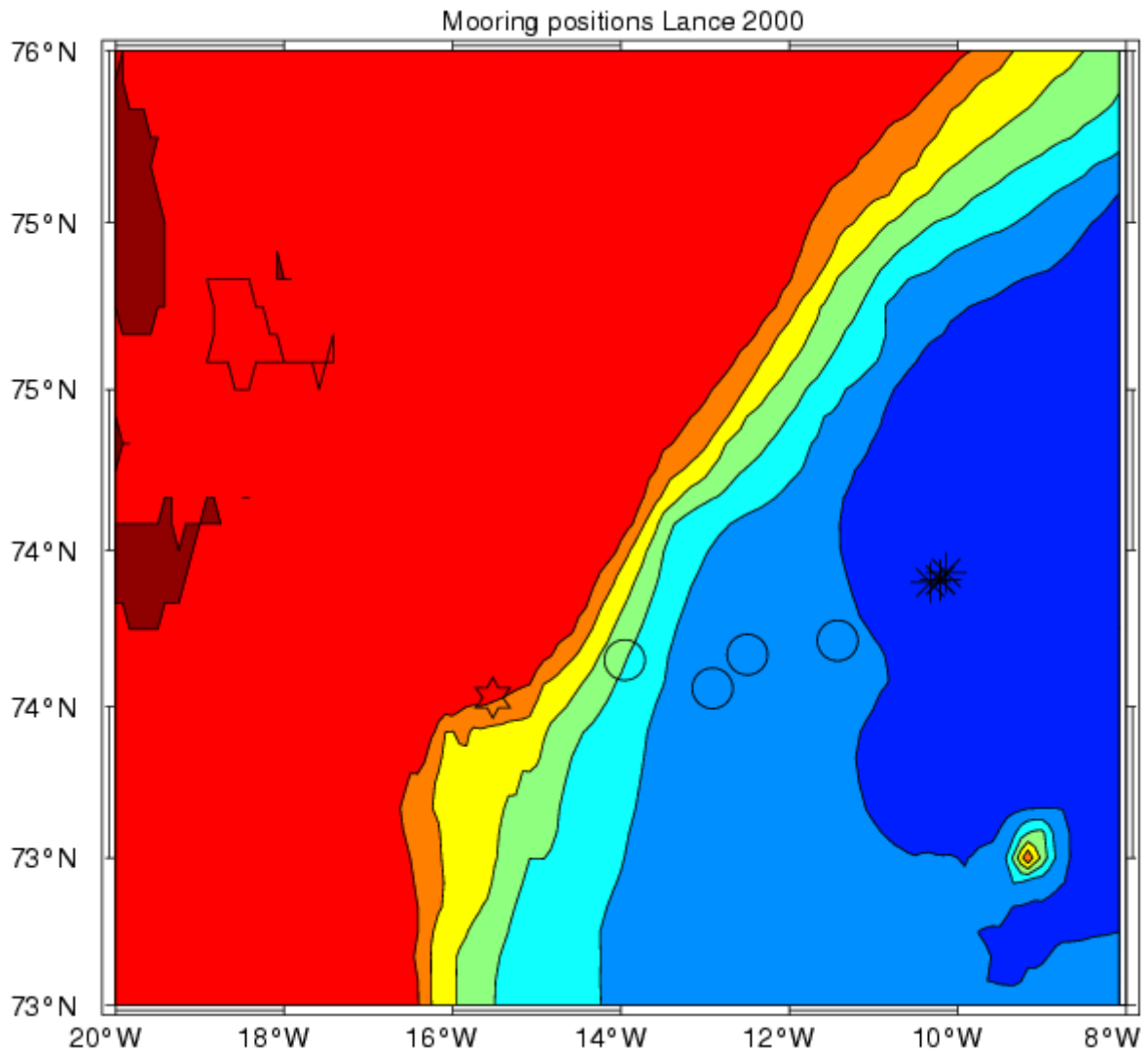


Figure 1: Position of the moorings.

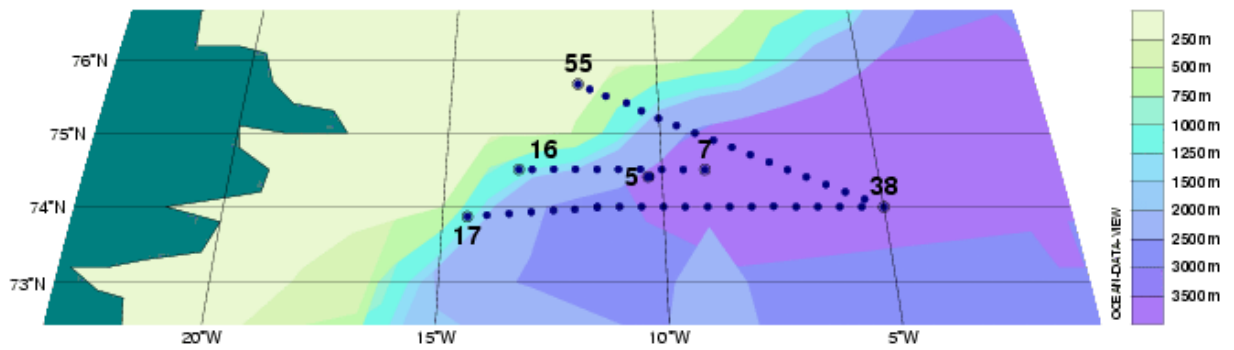
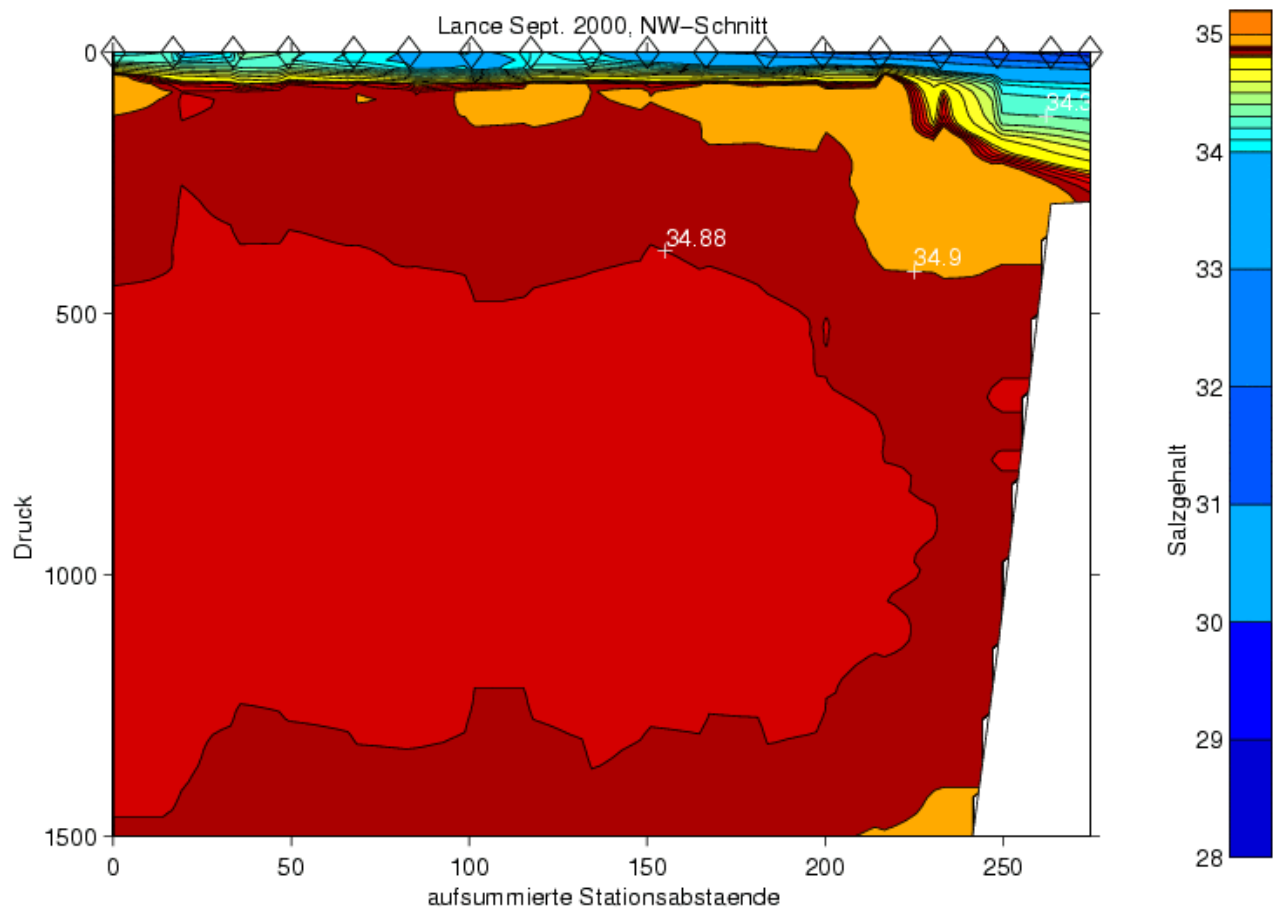
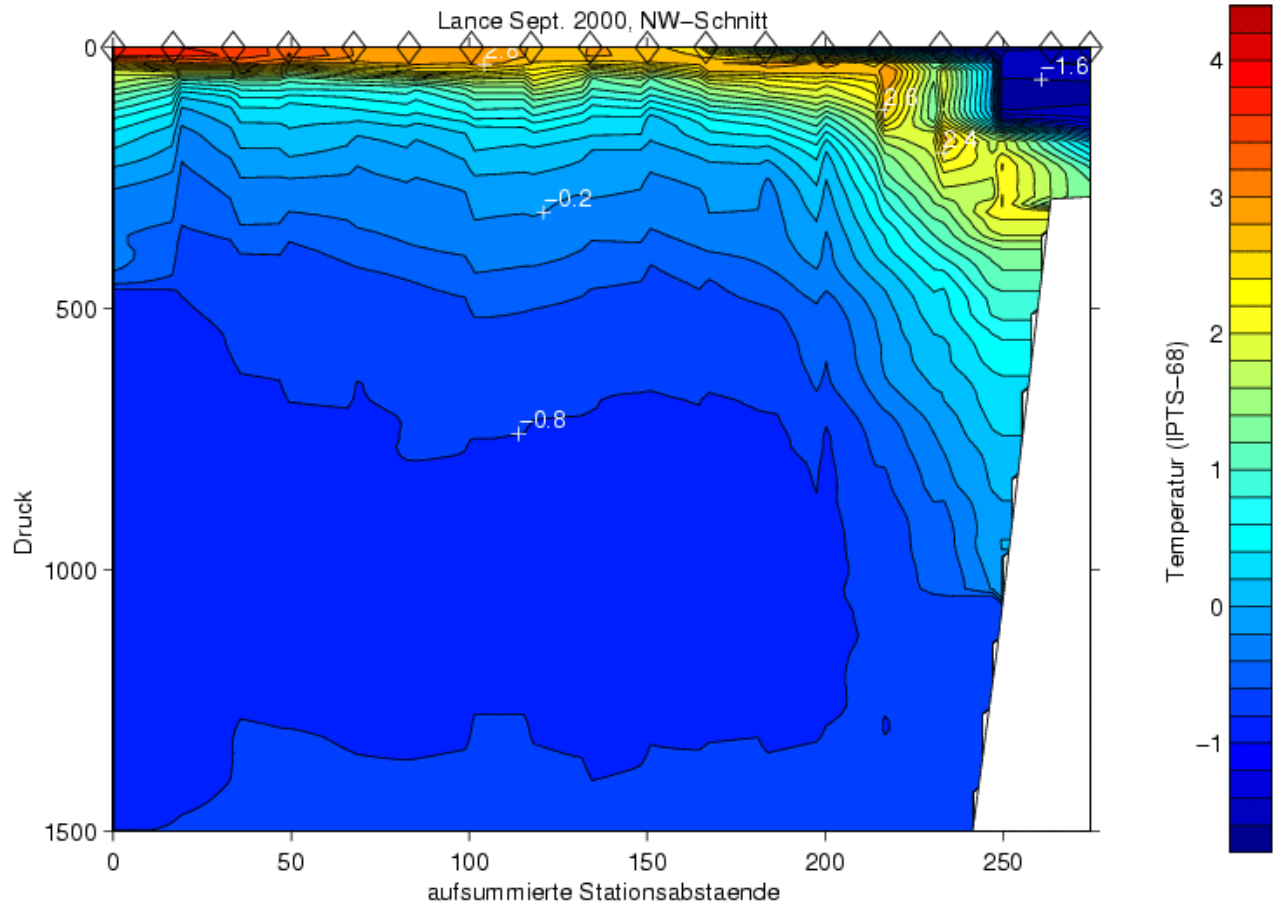


Figure2: Position of CTD casts.

First results

The data from the mooring recovered will be analyzed later on at land. The sediment traps in this mooring only worked for the first few months, due to a millennium bug in the sampling software. CTD data was processed on board, although no final, calibrated data is available. Visible on the sections is the polar water of the East Greenland current, very cold water with low salinity values that flows southward on the continental shelf and near the surface above the continental slope. The higher temperatures and salinities below are remains of the Atlantic Water, which after flowing northwards along the coast of Norway and Spitzbergen returns southwards with the deeper parts of the East Greenland current. Further offshore are the convectively formed water masses of the Greenland gyre.



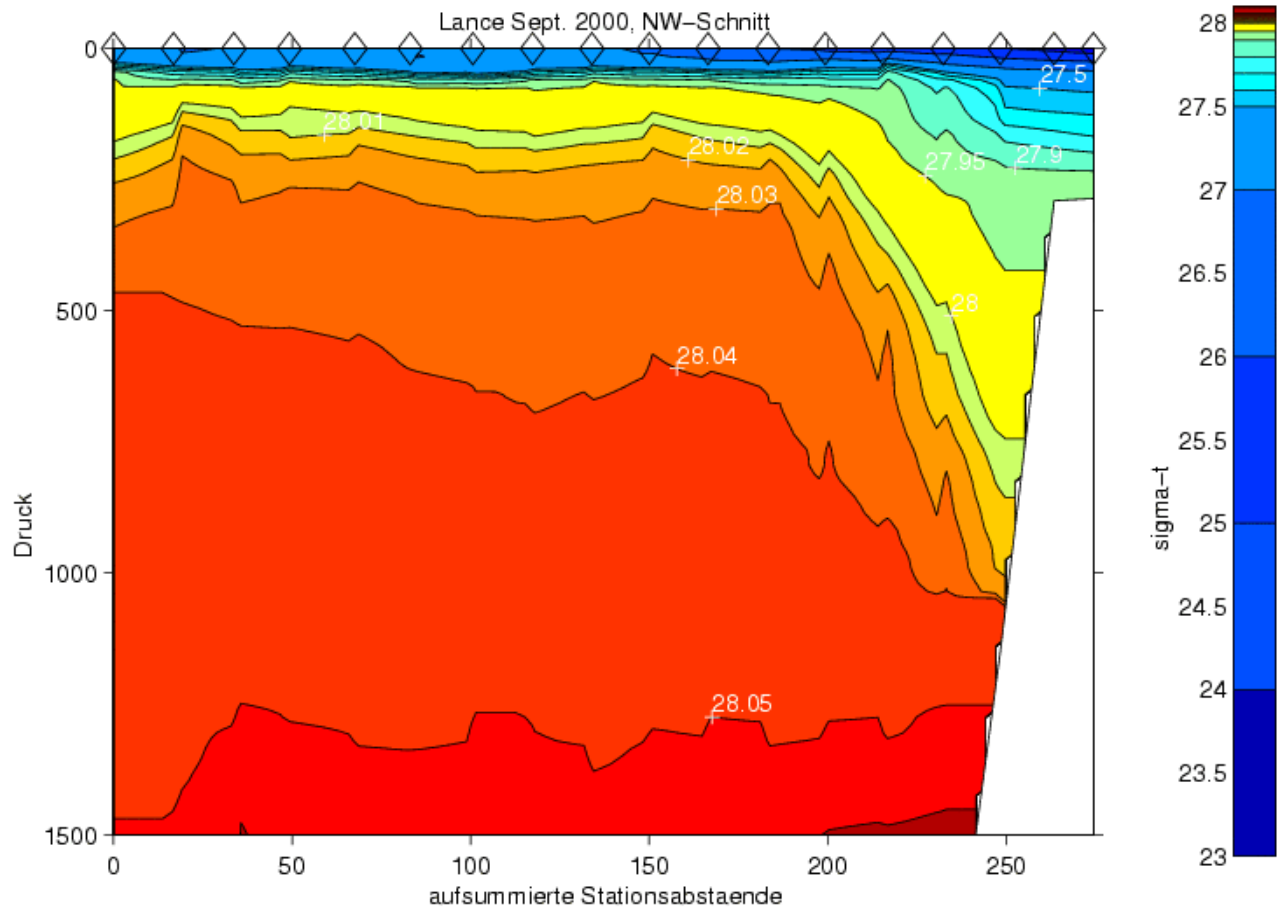


Figure 3: Temperature, salinity and density along section 3 from 74°N, 5°W (left) to 75°40'N, 12°W (right), stations 38 to 55.

Station summary

Table 1: Mooring positions

Mooring	Date	Latitude	Longitude	Depth	comments
AWI 419-1	16.09.2000	74°N24.40	10°W12.245	3240	recovery
AWI 419-2	17.09.2000	74°N24.40	10°W12.245	3240	deployment
AWI 420-1	18.09.2000	74°N23.929	10°W19.484	3210	deployment
AWI 421-1	20.09.2000	74°N25.75	10°W08.18	3240	deployment
ARK-HH1	23.09.2000	74°N12.80	11°W25.60	3045	deployment
ARK-HH2	23.09.2000	74°N10.08	12°W29.94	2920	deployment
ARK-HH3	24.09.2000	74°N03.55	12°W54.64	2820	deployment
ARK-HH4	24.09.2000	74°N09.03	13°W57.23	1910	deployment

Mooring	Date	Latitude	Longitude	Depth	comments
Rohr-1	22.09.2000	74°N01.716	15°W31.149	340	deployment

Table 2: CTD stations

Station	Date	Longitude	Latitude	Waterdepth[m]	Depth[m]
3	16.09.2000	10° 15.5 W	74° 12.7 N	3200	3200
4	17.09.2000	10° 16.0 W	74° 24.2 N	3210	500
5	18.09.2000	10° 19.2 W	74° 24.0 N	3210	1200
6	18.09.2000	10° 19.8 W	74° 24.0 N	3200	80
7	18.09.2000	08° 59.8 W	74° 29.9 N	3300	1500
8	18.09.2000	09° 30.1 W	74° 29.9 N	3270	1500
9	19.09.2000	10° 00.0 W	74° 30.0 N	3240	1500
10	19.09.2000	10° 29.7 W	74° 30.2 N	3180	1500
11	20.09.2000	11° 00.1 W	74° 30.1 N	3120	600
12	20.09.2000	11° 29.9 W	74° 30.1 N	3030	1500
13	20.09.2000	12° 00.0 W	74° 30.2 N	2910	1500
14	21.09.2000	12° 30.2 W	74° 30.2 N	2730	1500
15	21.09.2000	13° 00.2 W	74° 30.0 N	2480	1500
16	21.09.2000	13° 18.5 W	74° 30.0 N	2220	1500
17	22.09.2000	14° 26.4 W	73° 52.1 N	2100	1500
18	22.09.2000	14° 00.1 W	73° 53.3 N	2330	1500
19	22.09.2000	13° 30.1 W	73° 54.5 N	2570	1500
20	22.09.2000	13° 00.1 W	73° 55.8 N	2730	1500
21	23.09.2000	12° 29.9 W	73° 57.1 N	2850	1500
23	23.09.2000	12° 00.9 W	73° 56.4 N	2910	1500
24	23.09.2000	11° 30.5 W	73° 59.6 N	2980	1500
25	24.09.2000	11° 30.1 W	73° 59.9 N	3030	1500
26	24.09.2000	11° 00.0 W	74° 00.0 N	3060	1500
27	24.09.2000	10° 29.8 W	74° 00.0 N	3120	1500
28	24.09.2000	10° 00.0 W	74° 00.0 N	3120	1500
29	24.09.2000	09° 30.5 W	73° 59.9 N	3180	1500
30	25.09.2000	08° 59.9 W	74° 00.0 N	3220	1500
31	25.09.2000	08° 29.9 W	74° 00.0 N	3250	1500

Station	Date	Longitude	Latitude	Waterdepth[m]	Depth[m]
32	25.09.2000	07° 59.9 W	74° 00.0 N	3290	1500
33	25.09.2000	07° 30.1 W	74° 00.4 N	3350	1500
34	25.09.2000	06° 59.5 W	74° 00.0 N	3390	1500
35	25.09.2000	06° 29.9 W	74° 00.0 N	3420	1500
36	25.09.2000	06° 00.1 W	74° 00.0 N	3480	1500
37	25.09.2000	05° 30.1 W	73° 59.9 N	3510	1500
38	25.09.2000	05° 00.0 W	73° 59.8 N	2990	1500
39	25.09.2000	05° 06.1 W	74° 24.6 N	3490	1500
40	26.09.2000	05° 49.5 W	74° 11.9 N	3480	1500
41	26.09.2000	06° 14.6 W	74° 17.9 N	3480	1500
42	26.09.2000	06° 40.3 W	74° 24.0 N	3430	1500
43	26.09.2000	07° 05.2 W	74° 29.8 N	3450	1500
44	26.09.2000	07° 29.3 W	74° 36.0 N	3440	1500
45	26.09.2000	07° 54.6 W	74° 42.0 N	3420	1500
46	26.09.2000	08° 19.5 W	74° 48.1 N	3370	1500
47	26.09.2000	08° 44.7 W	74° 53.8 N	3360	1500
48	26.09.2000	09° 10.1 W	74° 59.7 N	3340	1500
49	26.09.2000	09° 35.7 W	75° 05.9 N	3210	1500
50	27.09.2000	10° 00.8 W	75° 11.7 N	3060	1500
51	27.09.2000	10° 24.8 W	75° 17.9 N	2720	1500
52	27.09.2000	10° 45.9 W	75° 24.5 N	1960	1500
53	27.09.2000	11° 15.6 W	75° 30.2 N	1150	1030
54	27.09.2000	11° 38.9 W	75° 35.9 N	290	290
55	27.09.2000	11° 55.9 W	75° 40.1 N	286	280