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The joint Russian-Norwegian cruise 63 of RV *Professor Shtokman* in the Norwegian economic zone, Western Barents Sea, July-August 2004

Chief Scientist Dr. Elena Ivanova

Introduction

- The joint Russian-Norwegian scientific expedition with RV *Professor Shtokman* was organized by Shirshov Institute of Oceanology, Russian Academy of Sciences, and Bjerknes Center for Climate Research, University of Bergen according to the Agreement N 25/н-04. The cruise was conducted by Chief Scientist Dr. Elena Ivanova and Master Victor Klepikov.

The shipboard operations in the Norwegian economic zone were fulfilled according to

- Consent of Norwegian Directorate of Fisheries (June14, 2004),
- License of Norwegian Petroleum Directorate (N 418/2004, May 26, 2004),
- Permission of National Joint Headquarters Commander Naval Forces (May 12, 2004) for port calls,
- Permission of Svalbard Governor for Longyearbyen port call and operations in the Icefjord.

Scientific party was represented by 26 Russians, 2 Norwegians (Dr. Bjørg Risebrobakken and Mr. Dag Inge Blindheim) and 1 German. Crew contained 29 persons. RV *Professor Shtokman* left from port Kaliningrad (Russia) on July 21. Norwegian and German scientists embarked the ship in Bergen on July 24-25. The work in the Norwegian economic zone was carried out on June 28-August 5, and on August 11-12, 2004.

Objectives

The cruise was aimed to retrieve sediment cores from local topographic lows (depressions) with enhanced sedimentation rates in the Bear Island trough, Persey trough and Franz Victoria trough for high-resolution studies of postglacial paleoenvironments, Atlantic water input into the Barents Sea during the Holocene and the last millenium, and sedimentation processes (Figs. 1-2, Tables 1-3).

Main scientific results

15 gravity cores (Table 3) and 15 box-cores were retrieved within the Norwegian zone of the Barents Sea. Gravity corers recovered 3 to 5 m of postglacial bottom sediments from the Bear Island Trough, Persey Trough, Icefjord (Svalbard), and Ingoajupet depression (Fig. 2). These sediments overlay the glacial deposits with typical moraine structure and morphology recorded by parametric sub-bottom profiler system «SES-2000 medium». In particular, a series of moraine ridges at 200 to 300 m water depth on the western slope of the Bear Island Trough, at 76 deg. N evidence glacier front retreat from the trough towards Svalbard during the initial destruction of the Barents Sea ice sheet (Fig. 3).

The high-resolution profiler records accompanied by coring allow us to identify two major reflectors marking boundaries between three lithostratigrafic units in local depressions: the acoustically transparent Holocene unit, the stratified unit of the last deglaciation, and the underlying moraine of the last glaciation. The reflectors correlate with stepward decrease in water content (increase in density) of sediments. Lithology of recovered postglacial sediments is similar to that previously described in the Eastern Barents Sea during cruises 11 and 14 by RV "Akademik Sergei Vavilov" (Murdmaa and Ivanova, 1999). We distinguished following three lithostratigraphic units in the cores obtained.

Unit I identified as the Holocene consists of soft olive gray clay or silty clay. It commonly contains more or less abundant black iron sulfide (hydrotroilite) enriched inclusions suggesting early diagenetic sulfate reduction. Several centimeters thick brown oxidized layer commonly overlies the reduced sediment. Burrow mottling is a common sedimentary structure, and polychaeta tubes occur in the upper part of the unit.

Unit II attributed to the main phase of deglaciation is characterized by yellowish or brownish gray color shades, and a presence of sandy laminae suggesting deposition from gravity (suspension) flows. Bioturbation is absent. Density is higher, and water content is lower than those in the Unit I.

Unit III representing deposits of the initial deglaciation phase is composed of dark gray mixed sandy silty clay with gravel and pebble size angular rock fragments, likely iceberg rafted debris (IRD). The sediment is rather stiff.

Surface sediment samples and cores obtained from the Bear Island and Persey troughs point to reworking of sediments during the postglacial time, and to active winnowing of recent sediments by strong bottom currents. The cores obtained from Persey Trough are characterized by enhanced thickness of the last deglaciation layer (up to 2.5 m, Fig. 4), thus providing new data on the Barents Sea ice sheet melting accompanied by sediment transport from banks to troughs by periodical suspension flows. The reduced thickness of the Holocene section most probably results from the bottom currents activity. These currents might follow the troughs in between the morain ridges, which were distinguished by profiling with «SES-2000 medium».

The maximum thickness of the Holocene section (about 5 m) is established in the Ingoajupet depression, at Station PSh-5159, 60-km northward of the Norwegian coast (Fig. 2 and 5). The next layer are recovered:

Box core

0-7 cm – Clay (silty?), brownish gray, very soft, with rusty brown tubes, 1 mm thick, and an alive Crustacea (2 cm long) at the surface.

7-15 cm – Clay, olive gray, homogeneous, moderately stiff.

Gravity core

0-3 cm – Clay, brownish gray, very soft.

3-81 cm – Clay, brownish olive gray, with rare small (up to 2 mm) iron sulfide inclusions below 26 cm, moderately stiff, but of variable density owing to coring disturbance.

81-248 cm – Clay, light dusky brown (brownish gray?), soft, contains rare thin (up to 2 mm) black iron sulfide lenses and inclusions at 102-107 cm, 121-123 cm, 131-135 cm, 142-151 cm, as well as double laminae, 3 mm each, at 165-167 cm. Shell fragments and angular gravel grains occur at 118 cm, 178 cm, 196-198 cm, 216 cm. The sediment becomes denser, and contains more gravel below 190 cm.

248-299 cm– Silty clay, light dusky brown, without iron sulfide inclusions. Sand lenses and laminae, up to 3 mm thick, occur at 251, 271, 275, 276, 277, 280, 296-299 cm; gravel-size stiff clay lumps (pellets?) are fixed at 255 cm and 296-299 cm.

299-332 cm– Silty clay, brownish (olive?) gray, with iron sulfide inclusions more abundant in diffuse bands (interbeds) at 302-306 cm, 324-326 cm, and 330-332 cm. The sediment contains sand, gravel-size rock fragments (black shale), clay lumps and shell fragments.

332-348 cm – Clay, brownish olive gray, with iron sulfide, especially abundant at 332-336 cm.

348-434 cm– Silty clay, dark brownish (olive?) gray, locally to black, enriched in iron sulfide. Black lenses are noted at 352-355 cm, 368-372 cm; and almost black interbeds alternating with gray intervals occur at 377-380 cm, 394-396 cm, 402-404 cm, 417-418 cm, 432-433 cm. A sand lense is fixed at 394-396 cm, and a shell fragment is found at 370 cm. The sediment is rather stiff.

434-436 cm – Silty clay, brown, stiff, with a sand lense at 435 cm.

436-490 cm – Silti clay with sand admixture, brownish gray. Dark gray to black interbeds enriched in iron sulfide occur at 442-443 cm, 455-456 cm, 463-466 cm, 479-481 cm; and iron sulfide disappears below. Sand interbeds and lenses are noted at 436-438 cm, 444 cm, 448 cm, 450 cm, 451 cm, 456-457 cm. 467-468 cm, 470-471 cm, 473-474 cm, 480-481 cm, 483-484 cm. The sediment is stiff.

490-505 cm (disturbed core catcher sample) – Silty clay, dark brownish gray, with abundant iron sulfide inclusions at 498-502 cm, intensely bioturbated. The sediment is stiff.

The lower part of the Holocene section in the core contains rather diverse and abundant foraminiferal assemblages. Sandy laminae occur in the lower part of the core section. They reflect activity of near-bottom suspension flows transporting sediments via submarine canyons from Norwegian fjords. We suppose that the marine conditions with rather high bioproductivity followed by a normal hemipelagic sedimentation started here likely few hundred years earlier than in the northern troughs and much earlier than in the central part of the sea due to the surface Atlantic water influx by the North Cape current along the Norwegian coast.

In a few cores, 3 to 4 m thick Holocene section contains rather abundant assemblages of benthic and planktic foraminifers suitable for the further high-resolution paleoceanographic study (Table 4). Such high sedimentation rates (30 to 40 cm/1000 years) are first recovered in the open Barents Sea. They resulted from intense redistribution of suspended matter from banks (e.g. the Persey Rise) to local depressions. Our new materials allow to highlight the interaction of Atlantic and Arctic waters at the Polar Front, and to compare these data with the Holocene variability of the latitudinal overturning (i.e. THC intensity).

Sediment sampling and sub-bottom profiling with «SES-2000 medium» carried out in several steep-sloped holes on the Bear Island shoal, western Svalbard shelf, and the Icefjord (Figs. 6-9) revealed small sediment bodies on their bottom. The sediments consist of fine-grained mud with abundant coarse rock debris likely derived from the nearby melting glaciers, and transported either by iceberg rafting or by gravity flows.

Geological sampling was supplemented by CTD measurements in order to investigate modern water column structure as a reference to paleoenvironmental study (Figs. 10-14, and attachement with CTD data).

Conclusion

Materials of the expedition are actually under the joint Russian-Norwegian study at Shirshov Institute of Oceanology and Bjerknes Centre for Climate Research. The success of the expedition is mainly based on the excellent cooperation between crew and scientists. Preliminary cruise results were presented at 32 International Geological Congress (Florence, 2004), Bjerknes Centennial Conference (Bergen, 2004), Workshop on LOIRA Program (Moscow, 2004). They demonstrate that the materials obtained during the expedition provide us with the new insight on the Western Barents Sea environments, climate changes, and interaction with the global thermohaline circulation during the last 15 – 20 kyr. Final results will be submitted to international scientific journals.

Table 4

Foraminiferal occurrence in the sediment samples

N	*Station*	*Section and level, cm*	*Foraminiferal occurrence*
1	PSh 63-5138/box-corer	8-10	rare
2	PSh 63-5138/gravity corer	I(2-4)	rare
3	PSh 63-5138/ gravity corer	I(98-100)	rare
4	PSh 63-5138/ gravity corer	II(30-32)	rare
5	PSh 63-5140/ gravity corer	I(16-18)	absent
6	PSh 63-5140/ gravity corer	2-4	rare
7	PSh 63-5141/ box-corer	base >100	rare
8	PSh 63-5141/ gravity corer	I(22-24)	common
9	PSh 63-5141/ gravity corer	II(2-4)	rare
10	PSh 63-5141/ gravity corer	II(22-24)	rare
11	PSh 63-5141/ gravity corer	II(42-44)	rare
12	PSh 63-5141/ gravity corer	II(62-64)	rare
13	PSh 63-5141/ gravity corer	II(82-84)	absent
14	PSh 63-5141/ gravity corer	II(102-104)	rare
15	PSh 63-5141/ gravity corer	II(122-124)	rare
16	PSh 63-5142/ box-corer	0-2	rare
17	PSh 63-5142/ gravity corer	I(2-4)	rare
18	PSh 63-5142/ gravity corer	I(22-24)	rare
19	PSh 63-5142/ gravity corer	I(42-44)	absent
20	PSh 63-5145/ box-corer	middle	rare
21	PSh 63-5146/ box-corer	middle	rare
22	PSh 63-5146/ gravity corer	Core catcher	absent
23	PSh 63-5147/ gravity corer	I(2-4)	rare
24	PSh 63-5147/ gravity corer	I(22-24)	rare
25	PSh 63-5147/ gravity corer	I(42-44)	rare
27	PSh 63-5147/ gravity corer	I(82-84)	rare
28	PSh 63-5147/ gravity corer	I(122-124)	rare
29	PSh 63-5147/ gravity corer	II(24-26)	rare
30	PSh 63-5147/ gravity corer	II(42-44)	absent
31	PSh 63-5147/ gravity corer	II(64-66)	absent
32	PSh 63-5147/ gravity corer	II(84-86)	rare
33	PSh 63-5147/ gravity corer	II(104-106)	rare
34	PSh 63-5147/ gravity corer	II(124-126)	absent
35	PSh 63-5149/ box-corer	mixed sample	common
36	PSh 63-5150/ box-corer	22-24	common
37	PSh 63-5150/ gravity corer	I(42-44)	common
38	PSh 63-5150/ gravity corer	II(2-4)	rare
39	PSh 63-5150/ gravity corer	II(22-24)	common
40	PSh 63-5150/ gravity corer	II(62-64)	rare
41	PSh 63-5150/ gravity corer	II(82-84)	common
42	PSh 63-5150/ gravity corer	II(122-124)	common
43	PSh 63-5151/ gravity corer	III(102-104)	rare
44	PSh 63-5151/ gravity corer	IV(62-64)	rare
45	PSh 63-5155/ box-corer	0-2	rare
46	PSh 63-5155/ box-corer	2-4	rare
47	PSh 63-5155/ box-corer	22-23	rare
48	PSh 63-5155/ gravity corer	I(2-4)	rare

49	PSh 63-5155/ gravity corer	I(22-24)	rare
50	PSh 63-5155/ gravity corer	I(42-44)	rare
51	PSh 63-5155/ gravity corer	II(2-4)	rare
52	PSh 63-5155/ gravity corer	II(22-24)	rare
53	PSh 63-5155/ gravity corer	II(42-44)	rare
54	PSh 63-5156/ gravity corer	II(62-64)	rare
55	PSh 63-5155/ gravity corer	II(82-84)	rare
56	PSh 63-5155/ gravity corer	II(102-104)	rare
57	PSh 63-5155/ gravity corer	II(122-124)	rare
58	PSh 63-5155/ gravity corer	III(2-4)	rare
59	PSh 63-5155/ gravity corer	III(22-24)	rare
60	PSh 63-5155/ gravity corer	III(42-44)	rare
61	PSh 63-5155/ gravity corer	III(62-64)	rare
62	PSh 63-5155/ gravity corer	III(82-84)	rare
63	PSh 63-5155/ gravity corer	III(102-104	rare
64	PSh 63-5155/ gravity corer	III(122-124)	rare
65	PSh 63-5156/ grab	mixed sample	common
66	PSh 63-5157/ gravity corer	I(2-4)	rare
67	PSh 63-5157/ gravity corer	I(22-24)	rare
68	PSh 63-5157/ gravity corer	I(42-44)	rare
69	PSh 63-5157/ gravity corer	I(62-64)	rare
70	PSh 63-5157/ gravity corer	II(2-4)	rare
71	PSh 63-5157/ gravity corer	II(22-24)	common
72	PSh 63-5157/ gravity corer	II(42-44)	rare
73	PSh 63-5157/ gravity corer	II(62-64)	rare
74	PSh 63-5157/ gravity corer	II(82-84)	rare
75	PSh 63-5157/ gravity corer	II(102-104)	rare
76	PSh 63-5159/ gravity corer	I(2-4)	rare
77	PSh 63-5159/ gravity corer	I(22-24)	rare
78	PSh 63-5159/ gravity corer	I(42-44)	rare
79	PSh 63-5159/ gravity corer	I(62-64)	rare
80	PSh 63-5159/ gravity corer	I(82-84)	rare
81	PSh 63-5159/ gravity corer	II(2-4)	common
82	PSh 63-5159/ gravity corer	II(22-24)	rare
83	PSh 63-5159/ gravity corer	II(42-44)	rare
84	PSh 63-5159/ gravity corer	II(82-84)	rare
85	PSh 63-22/ gravity corer	II(102-104)	rare
86	PSh 63-5159/ gravity corer	III(2-4)	rare
87	PSh 63-5159/ gravity corer	III(22-24)	absent
88	PSh 63-5159/ gravity corer	III(42-44)	common
89	PSh 63-5159/ gravity corer	III(62-64)	rare
90	PSh 63-5159/ gravity corer	III(82-84)	rare
91	PSh 63-5159/ gravity corer	III(102-104)	rare
92	PSh 63-5159/ gravity corer	IV(2-4)	common
93	PSh 63-5159/ gravity corer	IV(22-24)	rare
94	PSh 63-5159/ gravity corer	IV(42-44)	absent
95	PSh 63-5159/ gravity corer	IV(62-64)	rare
96	PSh 63-5159/ gravity corer	IV(82-84)	rare
97	PSh 63-5159/ gravity corer	IV(102-104)	rare
98	PSh 63-5159/ gravity corer	IV(122-124)	rare

99	PSh 63-5159/ gravity corer	V(2-4)	rare
100	PSh 63-5159/ gravity corer	V(22-24)	rare
101	PSh 63-5159/ gravity corer	V(42-44)	absent

Table 1.

Описание прохождения основных точек маршрута

№ point	*Turn point*	*Course*	*Distance in miles*
	From Kalinigrad to Bergen		
1	φ=54°38’9 N λ=19°52’0 E	Northern entrance to Baliisk port	Pilot debarkment
2	φ=54°41’7 N λ=19°45’0 E	305°0	5.0
3	φ=54°54’0 N λ=18°30’0 E	287°0	45.5
4	φ=54°47’0 N λ=15°00’0 E	266°0	122.0
5	φ=55°12’0 N λ=12°39’9 E	287°0	84.5
6	φ=55°16’9 N λ=12°39’8 E	359°0	4.9
7	φ=55°32’2 N λ=12°43’3 E	7°0	15.5
8	φ=55°33’0 N λ=12°42’5 E	332°0	0.9
9	φ=55°45’0 N λ=12°40’7 E	335°0	12.0
10	φ=55°50’7 N λ=12°45’2 E	24°	6.3
11	φ=55°55’0 N λ=12°45’5 E	2°0	4.3
12	φ=55°58’4 N λ=12°42’4 E	333°0	3.8
13	φ=56°03’3 N λ=12°39’7 E	343°0	5.1
14	φ=56°07’9 N λ=12°32’0 E	317°0	6.3
15	φ=56°18’4 N λ=12°05’0 E	305°0	18.4
16	φ=56°45’4 N λ=11°54’0 E	347°0	27.7
17	φ=57°28’4 N λ=11°26’0 E	348°0	45.7
18	φ=57°47’4 N λ=10°47’0 E	312°0	28.3
19	φ=57°49’0 N λ=10°42’8 E	306°0	2.8
20	φ=57°49’0 N λ=7°10’2 E	270°0	113.7
21	φ=58°21’0 N λ=5°14’7 E	298°0	69.2

22	φ=58°28’8 N λ=5°08’3 E	337°0	8.5
23	φ=58°42’2 N λ=5°13’4 E	11°0	13.7
24	φ=59°09’1 N λ=4°40’5 E	328°0	32.0
25	φ=60°43’4 N λ=4°37’0 E	359°0	94.6
26	φ=60°44’4 N λ=4°40’4 E	59°0	2.0 pilot
			Σ=772.7
Distance from pilot station to Bergen – 31.0 miles			
Distance from Bergen to pilot debarkment – 35.0 miles			
Distance in Kaliningrad channel till the pilot station – 27 miles			
Total: Kaliningrad-Bergen-pilot debarkment			**865.7**

Bergen –Survey area - Longyear

1	φ=60°50’0 N λ=4°19’0 E	-	Pilot debarkment
2	φ=61°00’0 N λ=4°16’5 E	353°0	10.1
3	φ=61°42’2 N λ=4°22’0 E	3°6	42.4
4	φ=62°21’2 N λ=4°52’0 E	20°0	41.6
5	φ=66°20’0 N λ=10°10’0 E	30°0	276.5
6	φ=68°20’0 N λ=12°07’5 E	21°0	129.0
7	φ=73°35’0 N λ=21°00’0 E	29°0	360.7
			Σ=860.3
Survey area			
1	φ=73°35’0 N λ=21°00’0 E	-	-
2	φ=74°10’0 N λ=21°20’0 E	9°0	35.6
3	φ=74°17’0 N λ=21°00’0 E	322°0	8.9
4	φ=74°26’0 N λ=27°25’0 E	85°0	104.7
5	φ=75°29’0 N λ=30°20’0 E	36°0	78.0
6	φ=75°40’0 N λ=31°00’0 E	42°0	14.9
7	φ=76°15’0 N λ=34°00’0 E	51°0	56.2
8	φ=76°12’3 N	207°0	3.0

	λ=33°54’1 E		
9	φ=76°14’0 N λ=34°04’2 E	54°0	3.0
10	φ=76°01’3 N λ=32°39’2 E	238°0	24.1
11	φ=76°04’5 N λ=32°56’8 E	53°0	5.3
12	φ=75°59’7 N λ=32°28’8 E	234°0	8.3
13	φ=76°04’5 N λ=32°56’1 E	54°0	8.1
14	φ=75°40’0 N λ=30°00’0 E	240°0	50.0
15	φ=76°00’0 N λ=21°35’0 E	278°0	126.4
16	φ=76°14’0 N λ=17°30’0 E	283°0	60.7
17	φ=76°22’9 N λ=15°52.2 E	291°0	25.0
18	φ=77°03’5 N λ=13°20’5 E	319°0	54.0
19	φ=77°22’1 N λ=13°05’0 E	350°0	19.0
20	φ=78°04’7 N λ=12°50’22 E	356°0	43.0
21	φ=78°10’0 N λ=13°50’0 E	67°0	13.4
22	φ=78°14’0 N λ=15°50’0 E	71°9	12.9
23	φ=78°20’0 N λ=15°10’0 E	32°0	7.6
24	φ=78°16’7 N λ=15°23’4 E	144°0	4.6
			Σ=765.9

Longyear – Tromse

1	φ=78°16’3 N λ=15°25’6 E	-	-
2	φ=78°09’7 N λ=13°45’7 E	252°0	21.5
3	φ=78°04’7 N λ=12°50’2 E	246°0	12.6
4	φ=77°22.1 N λ=13°05’0 E	176°0	43.0
5	φ=77°03’6 N λ=13°19’0 E	170°0	19.0
6	φ=76°21’5 N λ=15°53’3 E	140°0	55.2
7	φ=76°20’6 N	91°0	38.1

	λ=18°39’9 E		
8	φ=76°53’2 N λ=22°57’2 E	62°0	70.0
9	φ=77°48’0 N λ=27°52’0 E	50°0	85.1
10	φ=77°48’2 N λ=29°33’7 E	89°0	22.0
11	φ=78°05’0 N λ=29°42’0 E	6°0	17.0
12	φ=78°19’6 N λ=31°23’0 E	55°0	25.4
13	φ=77°57’5 N λ=31°37’8 E	172°0	23.0
14	φ=78°33’7 N λ=33°04’8 E	26°0	40.5
15	φ=78°04’4 N λ=34°56’3 E	142°0	37.2
16	φ=78°50’0 N λ=37°32’0 E	34°0	55.4
17	φ=78°52’0 N λ=39°00’0 E	83°0	17.2
18	φ=78°56’0 N λ=41°58’0 E	83°0	35.0
19	φ=79°29’0 N λ=44°50.0 E	44°0	46.0
20	φ=79°52.2 N λ=46°49’0 E	43°0	32.0
21	φ=79°40’7 N λ=46°50’5 E	179°0	12.0
22	φ=79°28’7 N λ=44°22’4 E	246°0	30.0
23	φ=76°57’5 N λ=47°09’5 E	167°0	156.0
24	φ=75°35’2 N λ=47°17’3 E	179°0	83’0
25	φ=75°41’2 N λ=46°34’4 E	299°0	12.3
26	φ=73°22’0 N λ=46°02’3 E	184°0	140.0
27	φ=71°21’0 N λ=22°30’6 E	254°0	446.3
28	φ=70°10’4 N λ=20°19’0 E	212°0	83.3
29	φ=70°00’0 N λ=20°07’5 E	201°0	11.2
30	φ=69°52’4 N λ=19°47’7 E	222°0	10.3 pilot embarkment
			Σ=1675.6

Distance in fjord with pilot – 26 miles	
Total: Longyear – Tromse	**1701.6**

Tromse –Arkhangelsk

1	φ=69°51’0 N λ=19°50’0 E		pilot debarkment -
2	φ=70°00’0 N λ=20°09’5 E	37°0	11.2
3	φ=70°10’4 N λ=20°19’0 E	17°0	22.2
4	φ=70°43’0 N λ=21°18.7 E	32°0	38.5
5	φ=71°13’2 N λ=23°53’5 E	59°0	59.0
6	φ=71°17’9 N λ=25°40’4 E	82°0	35.0
7	φ=71°14’8 N λ=27°40’2 E	95°0	38.8
8	φ=71°12’6 N λ=28°20’4 E	100°0	13.2
9	φ=70°57’1 N λ=29°25’0 E	126°0	26.2
10	φ=70°47’6 N λ=30°19’6 E	118°0	19.5
11	φ=70°09’2 N λ=32°34’5 E	130°0	59.6
12	φ=69°16’8 N λ=36°22’6 E	124°0	95.2
13	φ=67°49’7 N λ=41°08’2 E	130°0	136.4
14	φ=66°57’2 N λ=41°34’9 E	169°0	54.0
15	φ=65°37’9 N λ=39°28’7 E	213°0	95.0
16	φ=65°20’5 N λ=39°25’7 E	184°0	17.0
17	φ=64°56’6 N λ=40°03’0 E	146°0	29.0 pilot embarkment
			Σ=749.8
Distance from Tromso till pilot debarkment – 26 miles			
Distance from pilot station to Arkhangelsk – 22 miles			
Total: Tromse – Arkhangelsk			**797.8**
Total distance of the cruise – 4992.5 miles			

Table 2

Shipboard operations during the cruise 63 of RV *Professor Shtokman*

№ №	*Station* *Date*	*Equipments*	*Type of work*	*Lat* *N*	*Long* *E*	*Time* *start*	*Time* *end*	*Wd* (m)
1	2	3	4	5	6	7	8	9
1	PSh63-5138 28.07 – 29.07	1. CTD 2. Bottles levels 490 m 170 m 35 m 25 m 3. box-corer 4. gravity corer	1. CTD-measurements 2. water sampling 3. sediment sampling 4. sediment sampling	73°34,99' 73°35,00' 73°35.14' 73°35,31'	21°00,30' 20°58,77' 20°59,34' 21°01,26'	21.05 21.35 22.45 01.07	21.30 22.30 23.10 01.41	500 497 497 501
2	PSh63-5139 29.07	1. box-corer	1. sediment sampling	74°10,20'	21°19,80'	08.27	08.50	267
3	PSh63-5140 29.07	1. CTD 2. bottles levels 395 m ×2 35 m ×2 28 m ×2 3. box-corer 4. gravity corer	1. CTD-measurements 2. water sampling 3. sediment sampling 4. sediment sampling	74°27,14' 74°27,08' 74°27,04' 74°26,96'	27°48,79' 27°48,99' 27°46,54' 27°45,72'	18.37 19.05 20.17 21.06	19.05 20.06 20.42 21.26	400 400 397 397
4	PSh63-5141 30.07	1. box-corer 2. gravity corer	1. sediment sampling 2. sediment sampling	75°29,089' 75°29,006'	30°20,068' 30°19,194'	07.32 08.08	07.55 08.24	374,1 371,8
5	PSh63-5142 30.07	1. CTD 2 bottles levels 345 m ×2 150 m x2 30 m 2 18 m x2	1. CTD-measurements 2. water sampling	75°40,179' 75°40,150'	31°00,425' 31°00,865'	10.31 10.50	10.50 12.15	351,8 352

		5 m ×2 3. box-corer 4. gravity corer 5. gravity corer	3. sediment sampling 4. sediment sampling 5. sediment sampling	75°40,469’ 75°40,755’ 75°40,496’	31°02,298’ 31°03,161’ 31°02,73’	12.17 13.07 14.04	12.35 13.35 14.20	354,4 355,0 353,5
6	PSh63-5143 30.07	1. box-corer 2. gravity corer	1. sediment sampling 2. sediment sampling	75°39,330’ 75°39,463’	30°14,186’ 30°15,505’	18.36 19.07	18.50 19.26	356 353
7	PSh63-5144 31.07	1 box-corer 2. gravity corer 3. gravity corer 3. multicorer	1. sediment sampling 2. sediment sampling 3. sediment sampling 4. sediment sampling	76°01,335’ 76°01,338’ 76°01,524’ 76°01,327’	32°39,793’ 32°39,297’ 32°39,764’ 32°38,897’	13.25 14.01 14.48 15.58	13.45 14.25 15.18 16.15	325 324 314 324
8	PSh63-5145 31.07	1. box-corer 2. gravity corer 3. box-corer	1. sediment sampling 2. sediment sampling 3. sediment sampling	76°04,65’ 76°04,62’ 76°04,63’	33°00,18’ 32°57,31’ 32°57,33’	18.13 19.06 19.34	18.35 19.20 19.49	314 319 313
9	PSh63-5146 31.07	1. box-corer 2. gravity corer 3. CTD	1. sediment sampling 2. sediment sampling 3. CTD-measurements	75°59,68’ 75°59,67’ 75°59,58’	32°28,90’ 32°29,69’ 32°29,00’	22.07 22.28 23.00	22.15 22.48 23.10	332 329 329
10	PSh63-5147 01.08	1. gravity corer	1. sediment sampling	76°04,54’	32°56,88’	01.06	01.27	314
11	PSh63-5148 02.08	1. box-corer	1. sediment sampling	77°03,63’	13°19,12’	14.37	14.46	433
12	PSh63-5149	1. box-corer 2. CTD 3. Bottles	1. sediment sampling 2. CTD-measurements 3. water sampling	77°22,08’ 77°21,89’ 77°21,39’	13°04,80’ 13°03,98’ 13°00,86’	18.15 18.35 19.07	18.27 18.52 19.15	259 264 250
14	PSh63-5151 03.08	1. box-corer 2. CTD 3. gravity corer 4. CTD 5. bottles levels 255 m ×2 150 m ×2 100 m ×2 60 m ×2	1. sediment sampling 2. CTD-measurements 3. sediment sampling 4. CTD-measurements 5. water sampling	78°20,480’ 78°20,508’ 78°20,828’ 78°20,812’ 78°19,563’	15°10,831’ 15°10,953’ 15°12,775’ 15°13,588’ 15°16,104’	09.33 09.42 10.12 10.43 11.34	09.40 09.55 10.35 10.55 13.06	263 260 249 251 245

		8 m ×2						
15	PSh63-5152 04.08	1. CTD 2. bottles levels 48 m ×2 22 m ×2 12 m ×2 6 m ×2 3. grab	1. CTD-measurements 2. water sampling 3. sediment sampling	76°45,00’ 76°44,68’ 76°43,11’	21°35,00’ 21°34,44’ 21°30,09’	23.04 23.20 00.33	23.12 00.20 00.40	49 56 59
16	PSh63-5153 05.08	1. CTD 2. water transperancy probe 3. box-corer 4. CTD	1. CTD-measurements 2.testing 3. sediment sampling 4. CTD-measurements	77°48,04’ 77°48,15’ 77°48,09’ 77°48,01’	27°56,68’ 27°52,25’ 27°50,59’ 27°50,38’	10.34 10.52 11.12 11.23	10.45 11.01 11.16 11.34	172 171 165 165
17	PSh63-5154 05.08	1. box-corer 2. CTD 3. gravity corer 4. bottles levels 330 m ×2 135 m ×2 40 m ×2 0 m ×2	1. sediment sampling 2. CTD-measurements 3. sediment sampling 4. water sampling	78°02,86’ 78°02,98’ 78°03,04’ 78°03,03’	29°42,05’ 29°42,16’ 29°41,56’ 29°42,16’	15.19 15.38 16.27 17.10	15.28 15.51 16.50 18.07	331 329 319 333
18	PSh63-5159 11.08	1. CTD 2. box-corer 3. gravity corer 4. gravity corer	1. CTD-measurements 2. sediment sampling 3. sediment sampling 4. sediment sampling	71°21,830’ 71°21,828’ 71°21,797’ 71°21,652’	22°49,509’ 22°38,269’ 22°38,770’ 22°38,810’	01.22 03.33 03.55 04.55	01.52 03.41 04.05 05.04	414 420 422 418
19	PSh63-5160 12.08	1. CTD 2. botles levels 410 m ×2 150 m ×2 90 m ×2 10 m ×2	1. CTD-measurements 2. water sampling	71°13,965’ 71°13,948	28°43,956’ 28°43,933’	18.24 18.40	18.38 19.44	411 411

Table 6.

Sediment gravity cores sampled during the cruise 63 by RV *Professor Shtokman* in the Norwegian economic zone

№	Station	Longitude (N), Latitude (E)	Water depth, m	Number of sections	Core length, cm	Comments
1	PSh 5138 rus	73°35′14 20°59′34	501	2	277	
2	PSh 5140 rus	74°26′96 27°45′72	397	1	56	
3	PSh 5141 rus	N 75°29′00 E 30°19′19	372	2	173	
4	PSh 5142 rus	N 75°40′76 E 31°03′16	355	1	61	
5	PSh 5142 nor	N 75°40′50 E 31°02′73	354	2	227	
6	PSh 5143 nor	N 75°39′46 E 30°15′50	353	2	197	
7	PSh 5144/1 nor	N 76°01′33 E 32°39′30	324	2	240	
8	PSh 5144/2 nor	N 76°01′52 E 32°39′76	314	1	140	
9	PSh 5146 nor	N 75°59′67 E 32°29′69	329	2	240	
10	PSh 5147 rus	N 76°04′54 E 32°56′88	314	2	253	
11	PSh 5148 rus	N 78°09′77 E 13°45′37	431	2	101	
12	PSh 5151 rus	N 78°20′83 E 15°12′78	249	4	422	
13	PSh 5154 rus	N 78°03′04 E 29°40′96	319	1	71	
14	PSh 5159 nor	N 71°21′80 E 22°38′77	422	2	253	upper section was lost
15	PSh 5159 rus	N 71°21′65 E 22°38′81	418	5	505	

Note: rus –Russian core (now at Shirshov Institute), nor –Norwegian core (now at Bjorknes Centre).

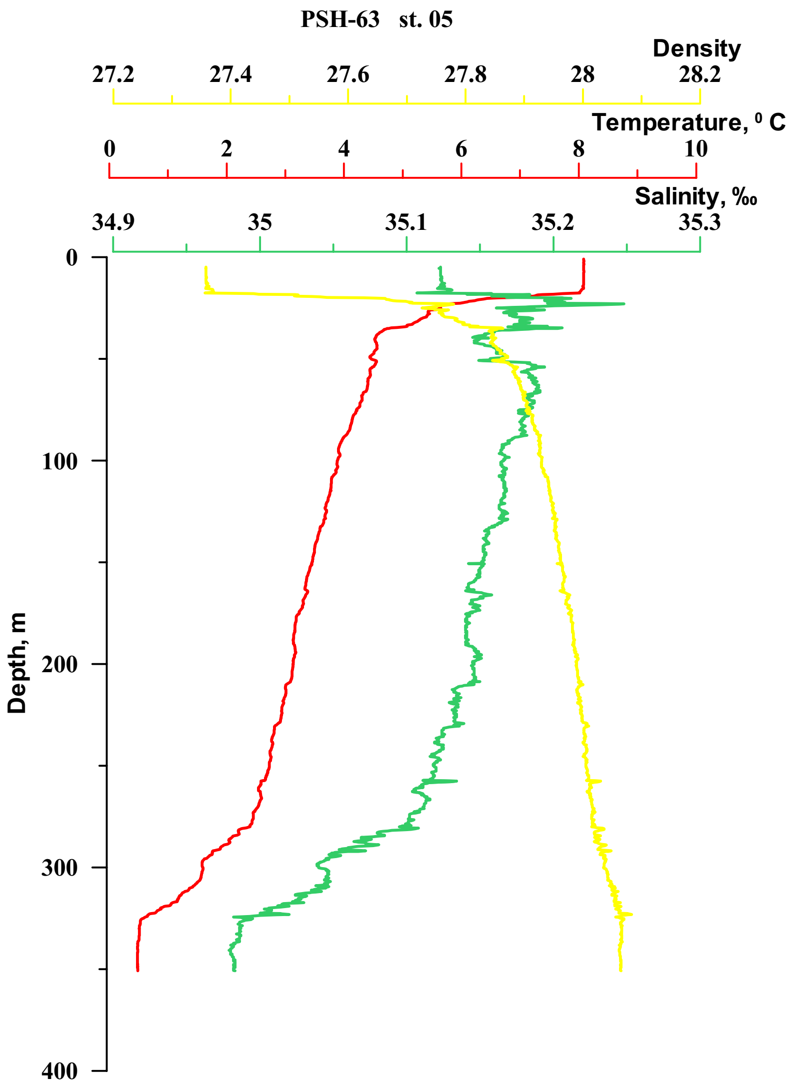

Fig. 11. CTD profile at Station 5 (= PSh 5142)

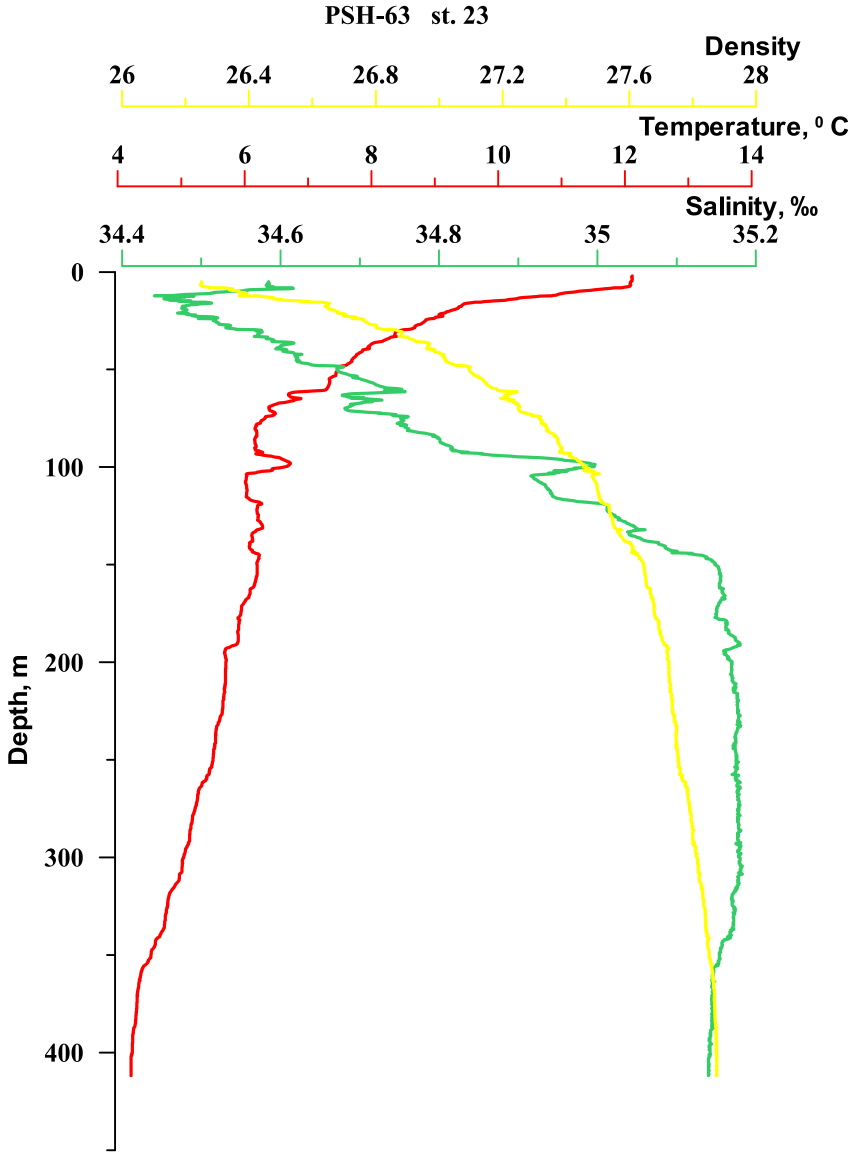

Fig. 14. CTD profile at Station 23 (= PSh 5160)

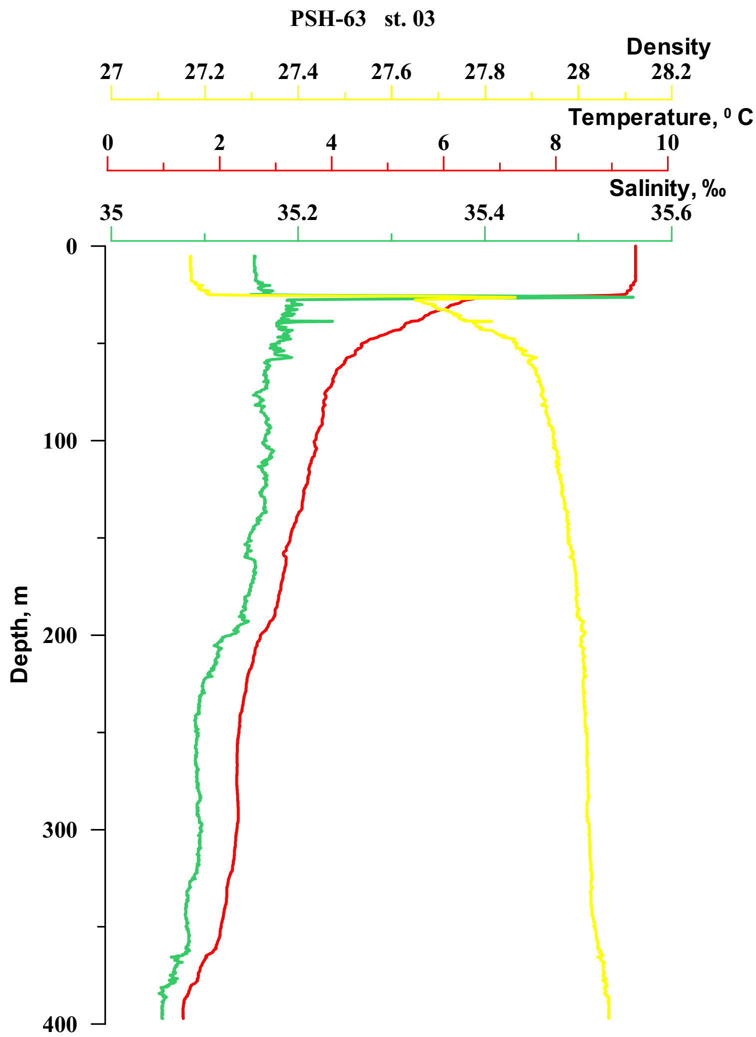

Fig. 10. CTD profile at Station 3 (= PSh 5140).

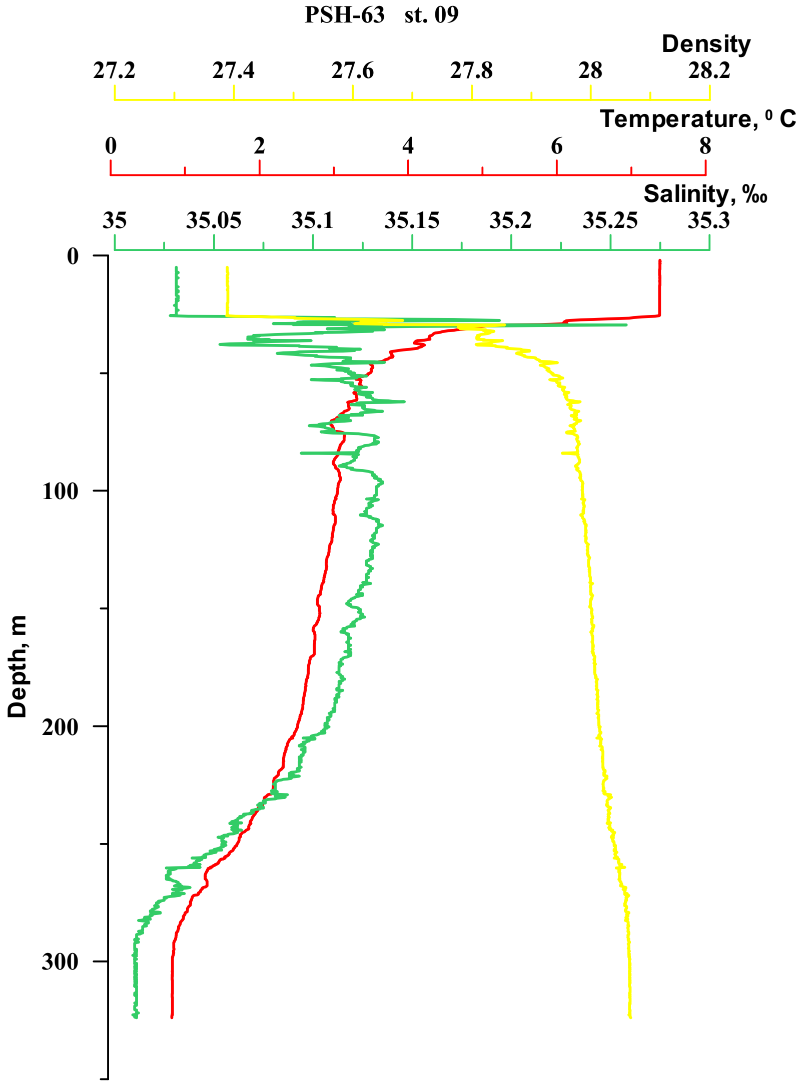

Fig. 12. CTD profile at Station 9 (= PSh 5146)

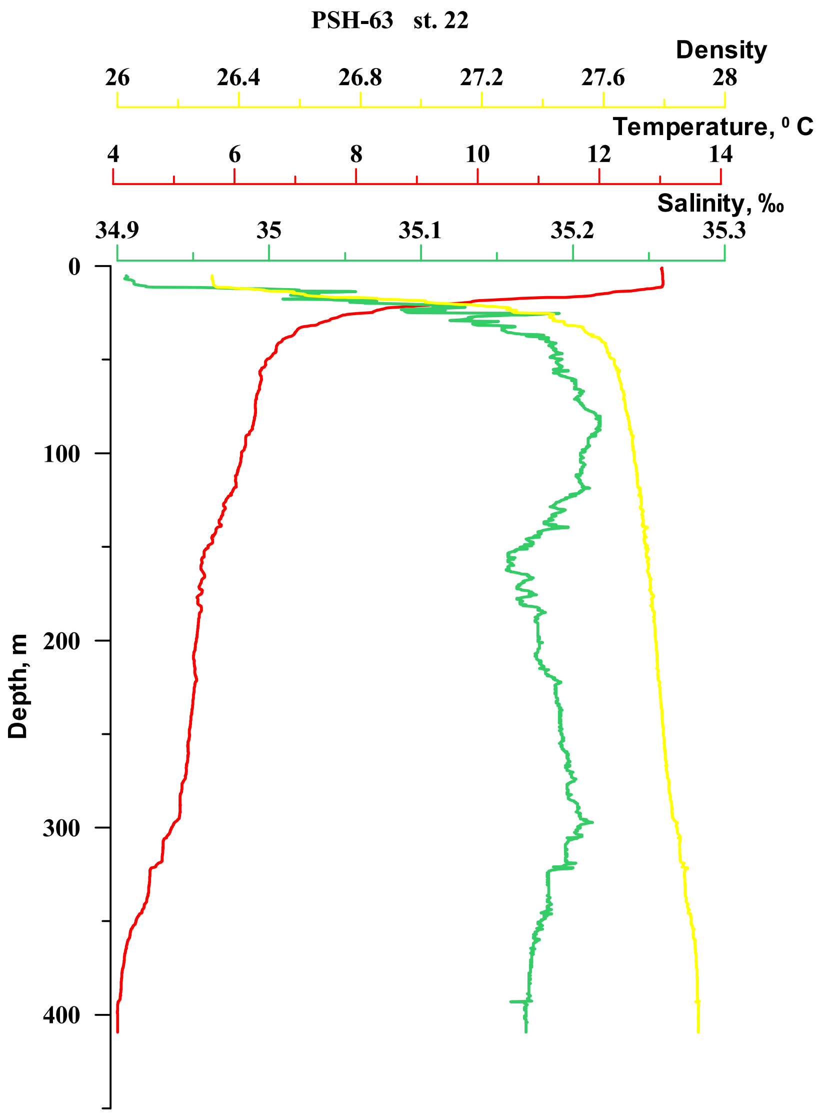

Fig. 13. CTD profile at Station 22 (= PSh 5159)

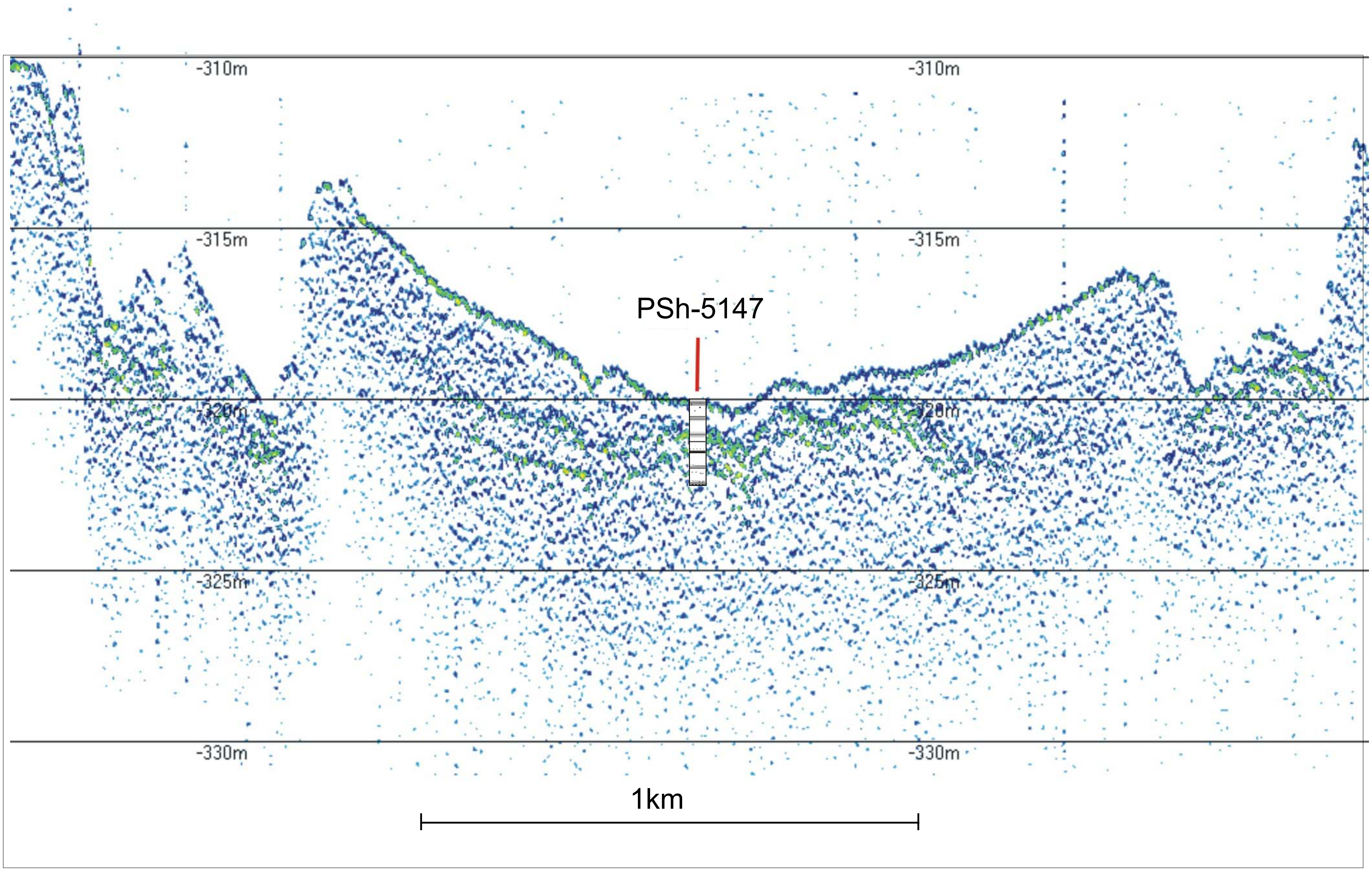

Fig. 4. SES-2000 profiling across the Persey trough.

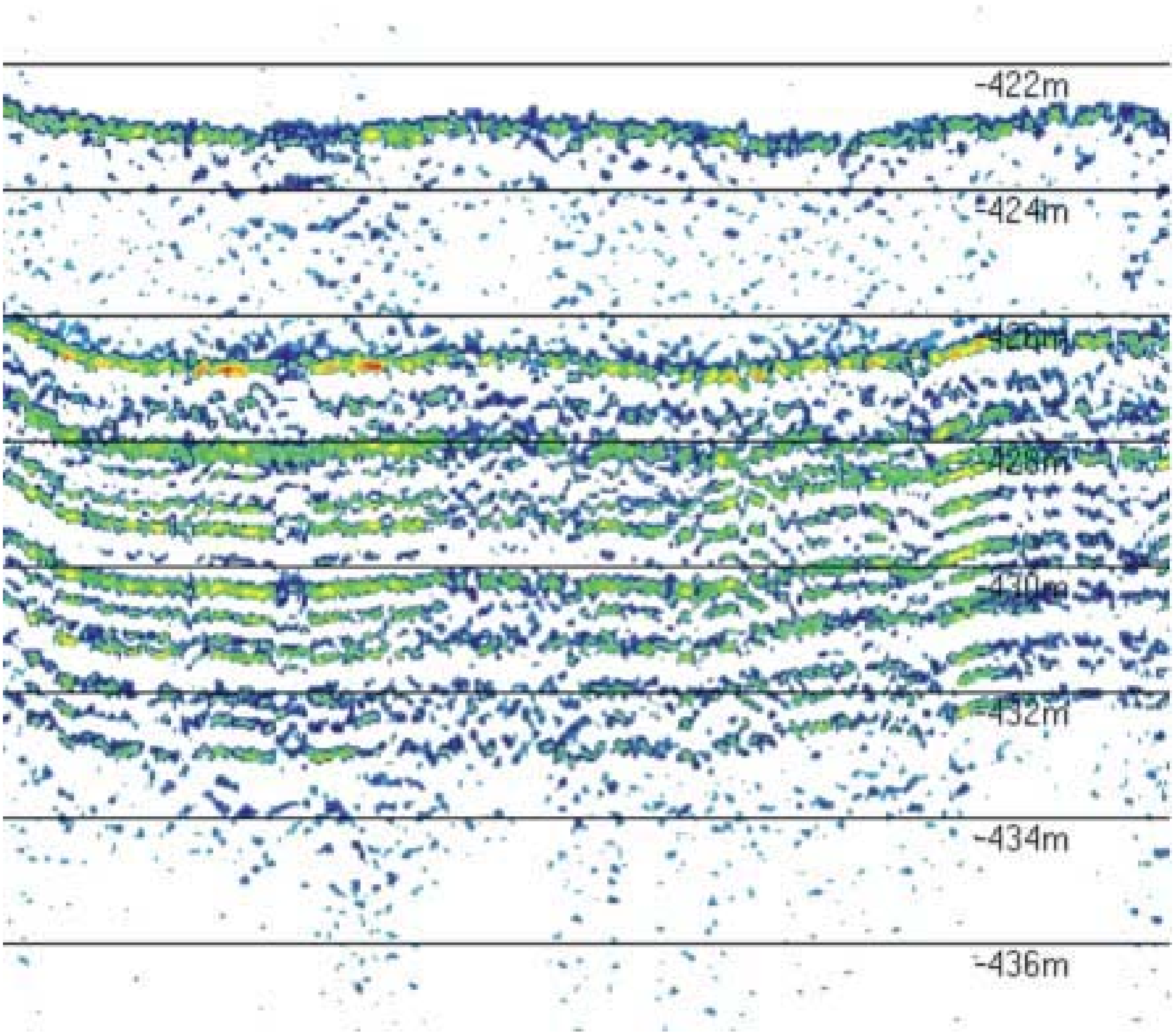

Fig. 5 SES-2000 profiling record at st. PSh 5159, Ingeyajupet Depression, Western Barents Sea

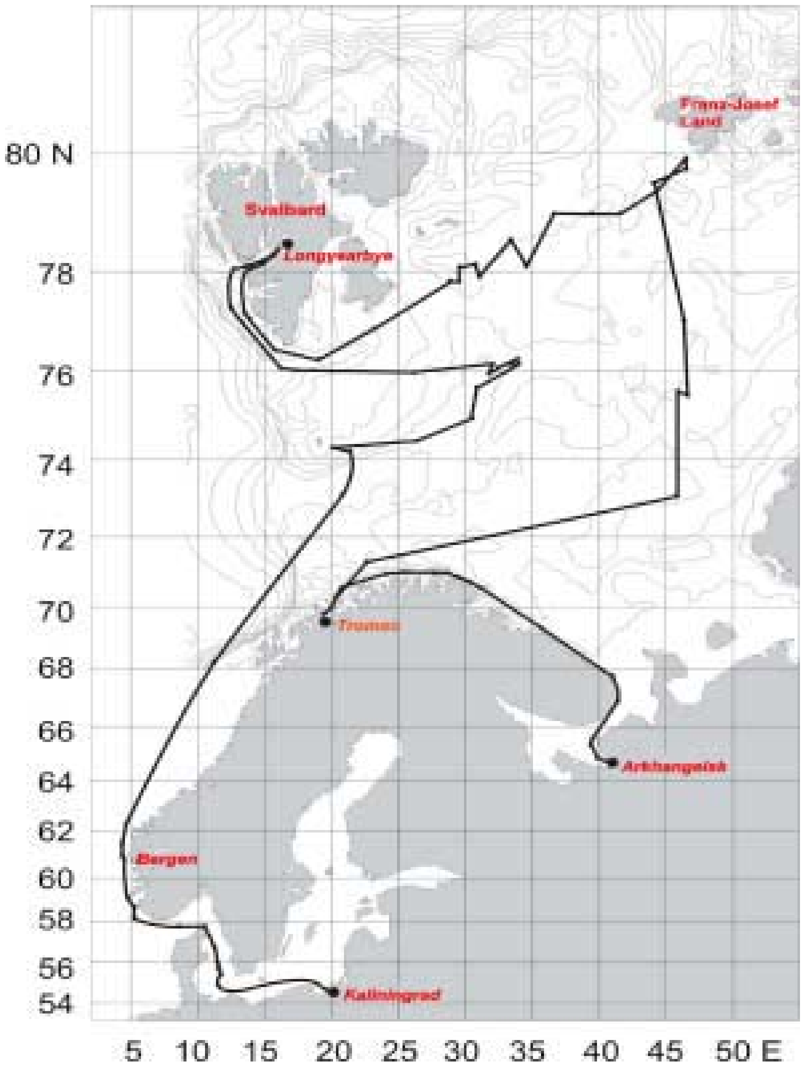

Fig. 1. Scheme of 63 cruise track by RV *Professor Shtokman,* July 21-August 14, 2004

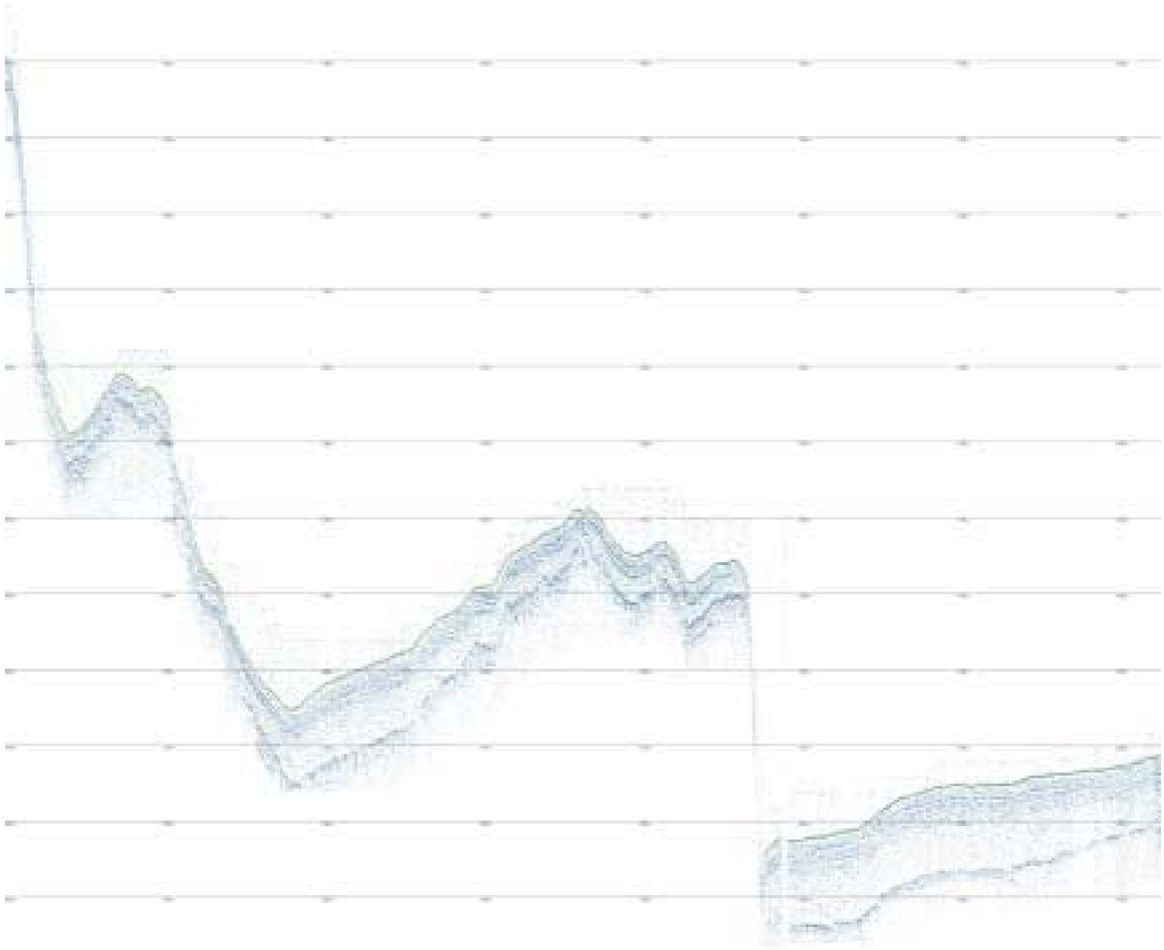

Fig. 9. SES-2000 profiling across the eastern part of Icefjord nearby St. PSh 5151

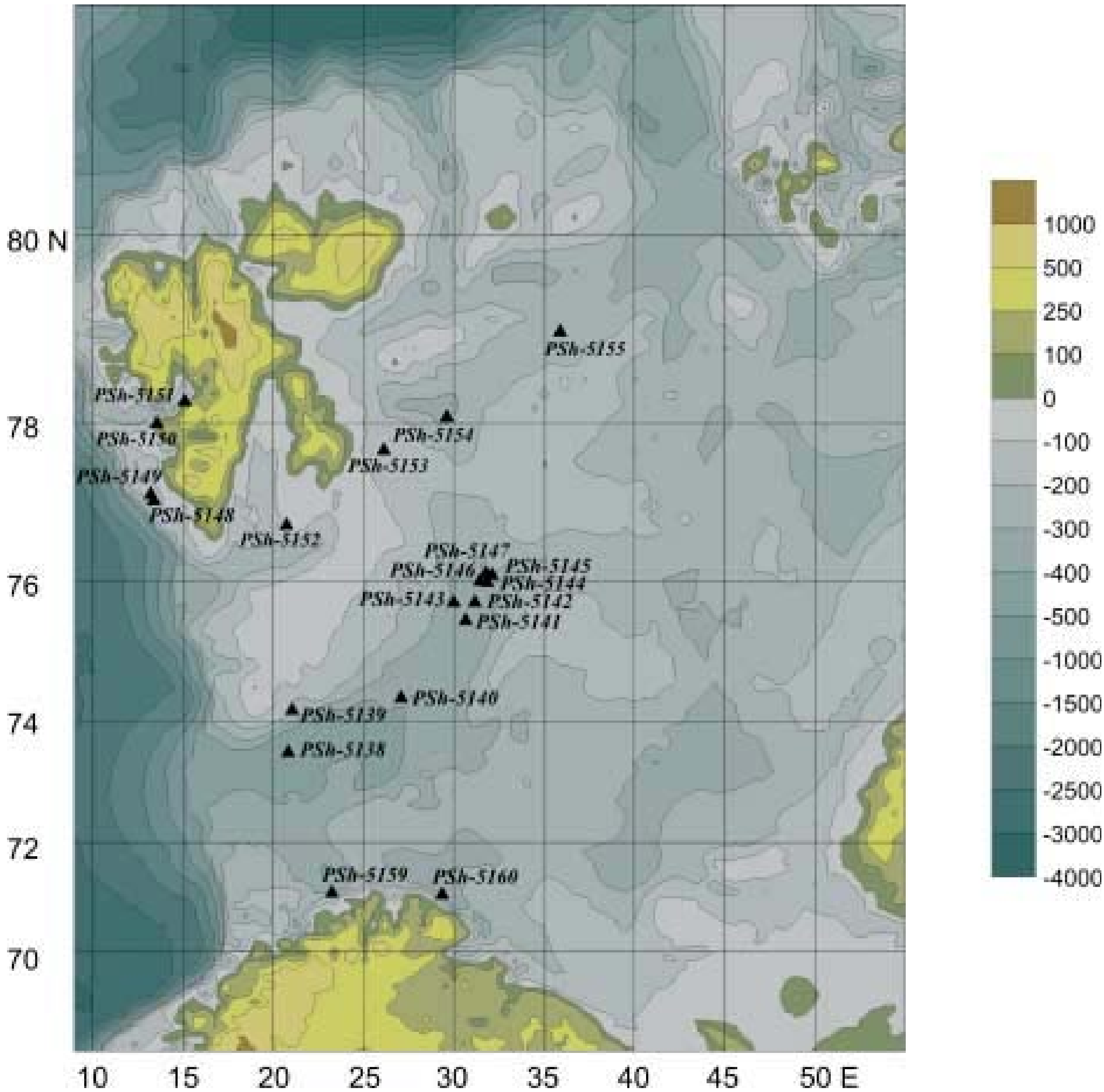

Fig. 2. Stations of cruise 63 by RV *Professor Shtokman* in Norwegian economic zone

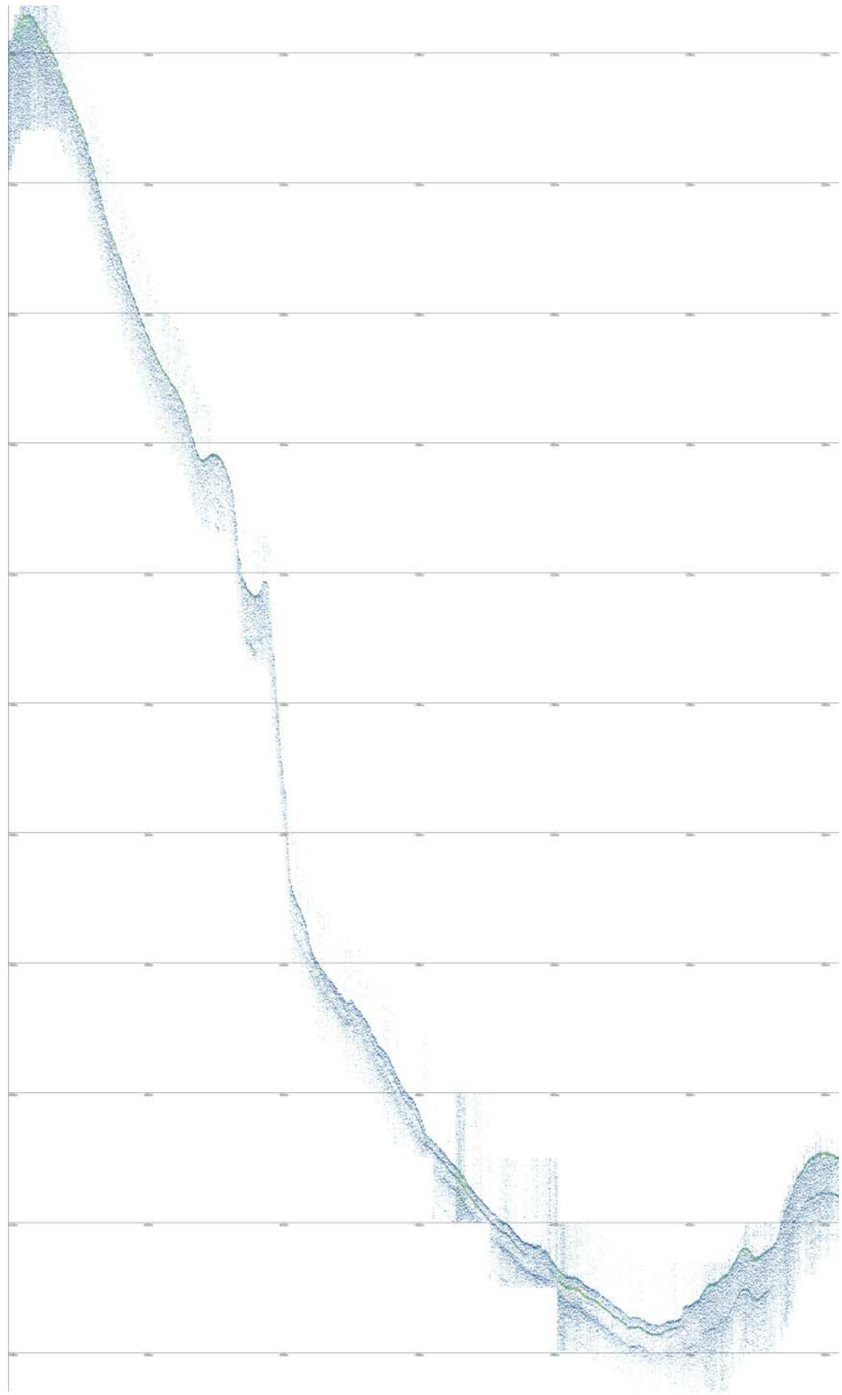

Fig. 8. SES-2000 profiling across the western part of Icefjord nearby St. PSh 5150.

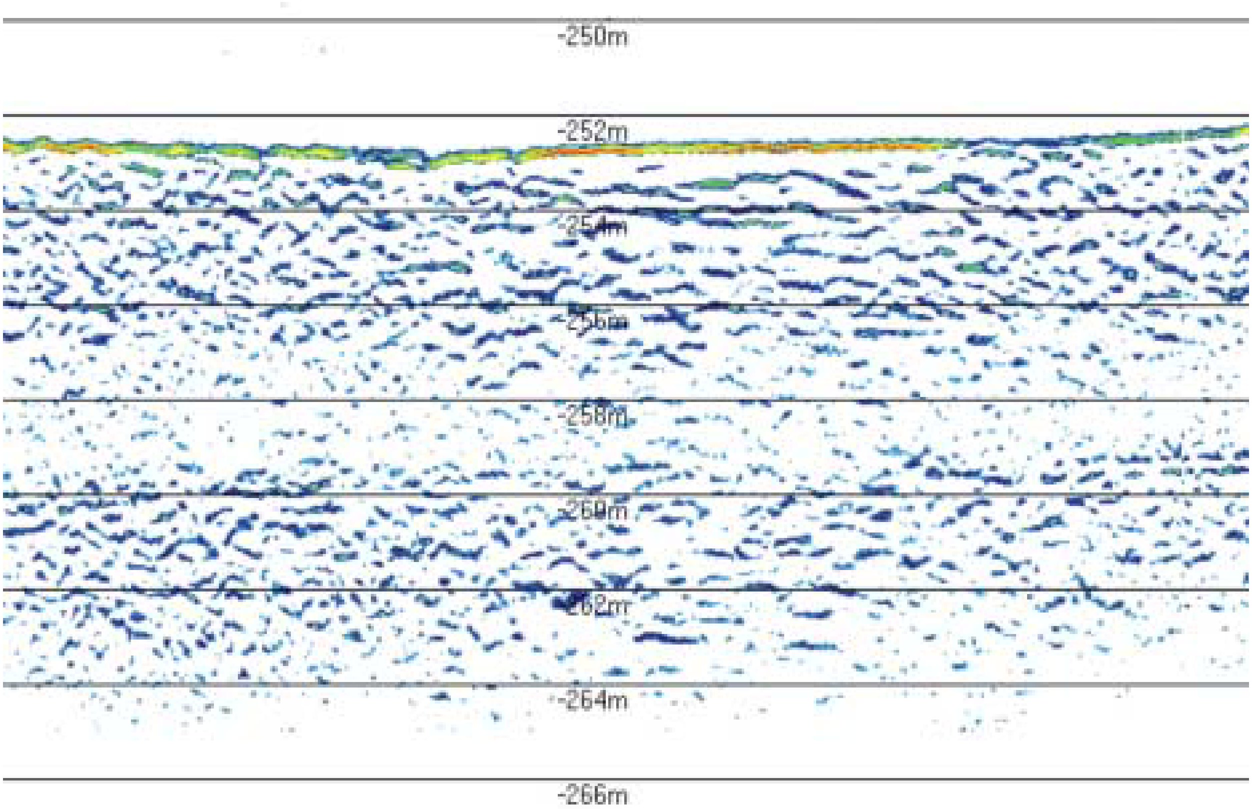

Fig. 7. SES-2000 profiling record at st. PSh 5151, Icefjord, Svalbard.

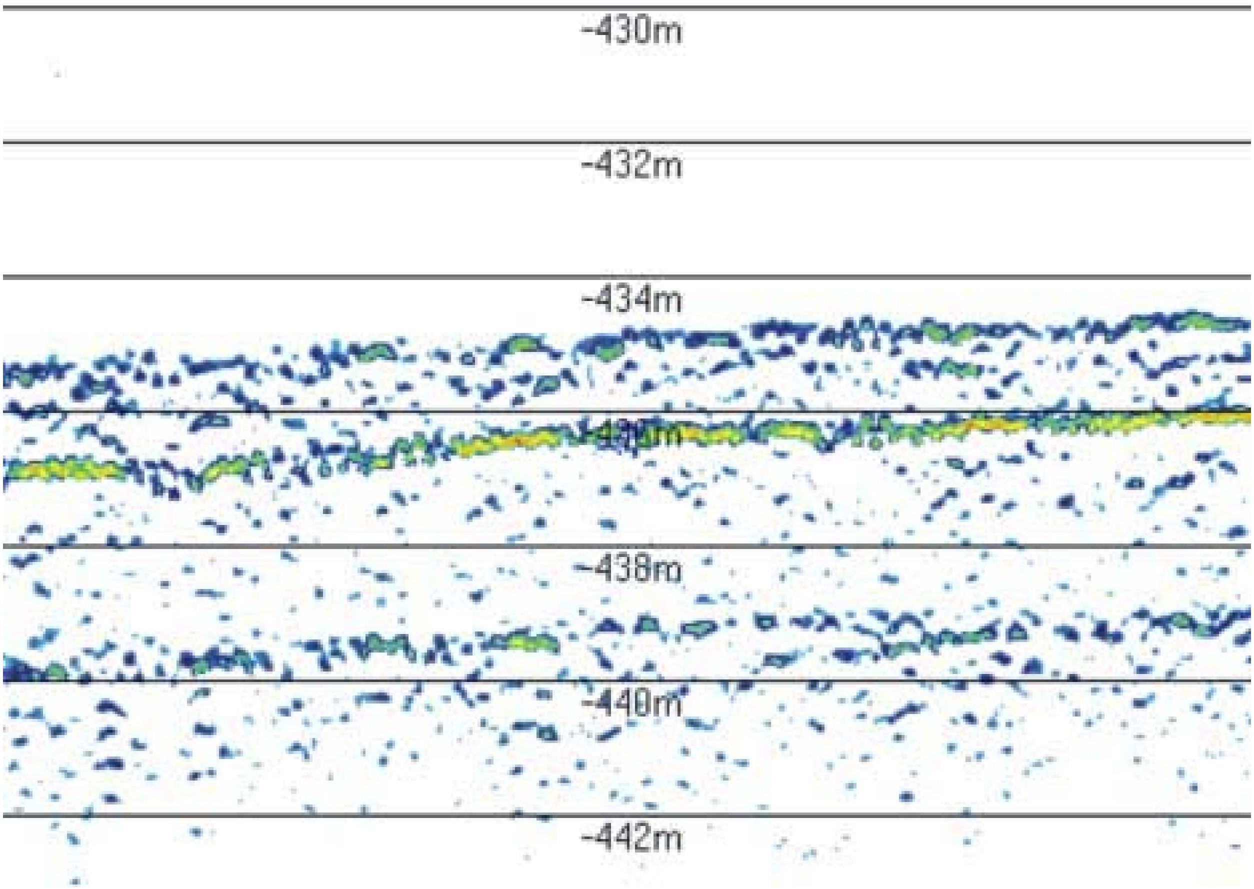

Fig. 6. SES-2000 profiling record at st. PSh 5150, Icefjord, Svalbard.

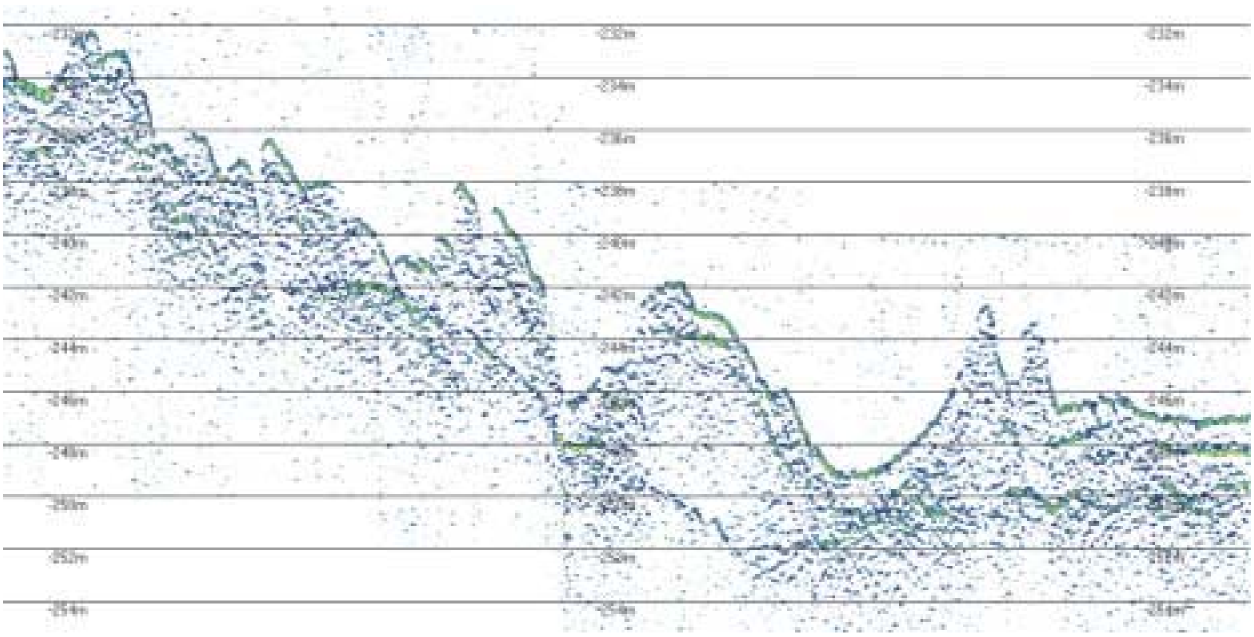

Fig. 3. Series of moraine ridges on the western slope of the Bear Island Trough at 76 N

Attachment

CTD measurements

Station PSh-5140		*Date 29.07.2004*	*Time 8:27*	*Lat., N 74,45233*	*Long, E 27,81317*
Station PSh	***Station PSh***	***Station PSh***			
10	9,424	35,153			
20	9,371	35,163			
30	6,175	35,204			
40	5,315	35,179			
50	4,546	35,177			
60	4,231	35,164			
70	4,015	35,168			
80	3,858	35,159			
90	3,831	35,166			
100	3,695	35,166			
110	3,64	35,165			
120	3,574	35,167			
130	3,488	35,164			
140	3,373	35,157			
150	3,26	35,147			
160	3,185	35,144			
170	3,13	35,152			
180	3,053	35,144			
190	2,983	35,14			
200	2,729	35,128			
210	2,622	35,114			
220	2,511	35,103			
230	2,454	35,097			
240	2,38	35,094			
250	2,343	35,092			
260	2,315	35,091			
270	2,31	35,092			
280	2,314	35,093			
290	2,333	35,093			
300	2,308	35,096			
310	2,269	35,093			
320	2,231	35,092			
330	2,128	35,084			
340	2,094	35,08			
350	2,029	35,081			
360	1,942	35,081			
370	1,679	35,069			
380	1,493	35,06			
390	1,355	35,055			

Station PSh -5142		Date 30.07.2004	Time 10:31	Lat., N 75,66967	Long, E 31,00767
Station PSh	***Station PSh***	***Station PSh***			
10	8,085	35,124			
20	6,678	35,206			
30	5,342	35,184			
40	4,527	35,148			
50	4,463	35,157			
60	4,405	35,186			
70	4,308	35,184			
80	4,138	35,178			
90	3,966	35,171			
100	3,887	35,166			
110	3,786	35,166			
120	3,722	35,164			
130	3,653	35,165			
140	3,531	35,155			
150	3,455	35,152			
160	3,351	35,144			
170	3,307	35,145			
180	3,17	35,142			
190	3,138	35,142			
200	3,131	35,146			
210	3,016	35,146			
220	2,958	35,134			
230	2,848	35,132			
240	2,776	35,125			
250	2,728	35,118			
260	2,564	35,111			
270	2,536	35,112			
280	2,392	35,095			
290	1,899	35,062			
300	1,594	35,04			
310	1,379	35,045			
320	0,876	35,006			
330	0,511	34,987			
340	0,483	34,98			
350	0,485	34,982			

Station PSh -5146		*Date 31.07.2004*	*Time 23:00*	*Lat., N 75,993*	*Long, E 32,48333*
Station PSh	***Station PSh***	***Station PSh***			
10	7,384	35,031			
20	7,381	35,031			
30	5,032	35,176			
40	3,979	35,119			
50	3,479	35,121			
60	3,305	35,129			
70	2,987	35,117			
80	3,1	35,132			
90	3,024	35,117			
100	3,054	35,132			
110	2,997	35,126			
120	2,975	35,131			
130	2,901	35,127			
140	2,84	35,125			
150	2,808	35,123			
160	2,74	35,114			
170	2,721	35,119			
180	2,636	35,116			
190	2,588	35,111			
200	2,513	35,106			
210	2,358	35,094			
220	2,255	35,088			
230	2,082	35,083			
240	1,887	35,061			
250	1,7	35,054			
260	1,337	35,043			
270	1,209	35,032			
280	0,995	35,018			
290	0,874	35,011			
300	0,827	35,01			
310	0,828	35,01			
320	0,829	35,01			

Station PSh -5149		***Date 02.08.2004***	***Time 18:15***	***Lat., N 77,36483***	***Long, E 13,06633***
Station PSh	***Station PSh***	***Station PSh***			
1	1,495	33,188			
10	1,526	33,305			
20	1,766	33,781			
30	1,933	34,121			
40	1,302	34,604			
50	-0,247	34,372			
60	-0,139	34,486			
70	0,633	34,554			
80	1,466	34,677			
90	1,519	34,716			
100	2,259	34,819			
110	3,28	34,961			
120	3,37	35			
130	3,277	34,991			
140	3,299	35,001			
150	3,174	34,987			
160	3,206	35,001			
170	3,295	35,029			
180	3,302	35,026			
190	3,372	35,052			
200	3,202	35,045			
210	3,16	35,033			
220	3,186	35,044			
230	3,079	35,03			
240	3,054	35,03			
250	3,062	35,032			
260	3,052	35,026			

Station PSh -5150		***Date 03.08.2004***	***Time 4:26***	***Lat., N 78,1655***	***Long, E 13,784***
Station PSh	***Station PSh***	***Station PSh***			
0	0,939	32,147			
10	0,932	32,15			
20	0,868	32,207			
30	1,001	32,525			
40	0,132	32,94			
50	0,271	33,074			
60	0,435	32,895			
70	0,081	33,84			
80	-0,315	34,22			
90	-0,824	34,317			
100	-0,946	34,356			
110	-0,902	34,382			
120	-0,269	34,484			
130	0,186	34,529			
140	0,461	34,567			
150	0,977	34,652			
160	1,173	34,686			
170	1,232	34,697			
180	1,748	34,76			
190	2,331	34,837			
200	2,55	34,873			
210	2,6	34,884			
220	2,431	34,875			
230	2,606	34,9			
240	2,631	34,906			
250	2,819	34,935			
260	3,065	34,972			
270	3,269	35,008			
280	3,383	35,022			
290	3,39	35,02			
300	3,599	35,058			
310	3,629	35,063			
320	3,674	35,073			
330	3,725	35,082			
340	3,762	35,088			
350	3,788	35,09			
360	3,821	35,1			
370	3,824	35,103			
380	3,841	35,108			
390	3,845	34,959			
400	3,85	35,112			
410	3,861	35,118			
420	3,862	35,118			

Station PSh -5151		***Date 03.08.2004***	***Time 10:43***	***Lat., N 78,34683***	***Long, E 15,2265***
Station PSh	***Station PSh***	***Station PSh***			
50	0,528	33,783			
60	-0,223	33,991			
70	-0,635	34,113			
80	-0,894	34,222			
90	-1,114	34,292			
100	-1,248	34,347			
110	-1,223	34,372			
120	-0,984	34,395			
130	-0,619	34,470			
140	-0,213	34,538			
150	0,258	34,571			
160	0,564	34,614			
170	0,862	34,666			
180	1,182	34,712			
190	1,359	34,739			
200	1,872	34,813			
210	2,134	34,853			
220	2,248	34,874			
230	2,324	34,886			
240	2,348	34,889			

Station PSh -5152		***Date 04.08.2004***	***Time 23:04***	***Lat., N 76,75***	***Long, E 21,58333***
Station PSh	***Station PSh***	***Station PSh***			
0	1,595	33,779			
10	1,36	33,966			
20	1,164	34,207			
30	1,114	34,263			
40	1,097	34,304			
50	1,086	34,331			

Station PSh -5153		***Date 05.08.2004***	***Time 10:34***	***Lat., N 77,80067***	***Long, E 27,94467***
Station PSh	***Station PSh***	***Station PSh***			
12	-0,482	33,576			
20	-1,487	33,96			
30	-1,786	34,035			
40	-1,802	34,115			
50	-1,809	34,063			
60	-1,819	34,121			
70	-1,789	34,130			
80	-1,616	34,199			
90	-1,522	34,218			
100	-1,465	34,233			
110	-1,218	34,350			
120	-0,919	34,403			
130	-0,731	34,487			
140	-0,364	34,539			
150	-0,184	34,575			
160	-0,163	34,596			

Station PSh -5154		***Date 05.08.2004***	***Time 15:38***	***Lat., N 78,04967***	***Long, E 29,70267***
Station PSh	***Station PSh***	***Station PSh***			
1	-1,64	33,942			
10	-1,642	33,943			
20	-1,643	33,938			
30	-1,721	33,958			
40	-1,76	34,04			
50	-1,777	34,095			
60	-1,759	34,132			
70	-1,662	34,184			
80	-1,405	34,239			
90	-1,068	34,307			
100	-0,916	34,354			
110	-0,725	34,405			
120	-0,586	34,433			
130	-0,316	34,502			
140	-0,049	34,555			
150	0,124	34,564			
160	0,14	34,31			
170	0,106	34,413			
180	0,12	34,658			
190	0,068	34,693			
200	0,137	34,709			
210	0,397	34,674			
220	0,315	34,77			
230	0,264	34,78			
240	0,294	34,821			
250	0,348	34,861			
260	0,438	34,888			
270	0,497	34,9			
280	0,594	34,924			
290	0,687	34,944			
300	0,818	34,965			
310	0,977	34,988			
320	1,009	34,928			

Station PSh -5159		***Date 11.08.2004***	***Time 1:22***	***Lat., N 71,37967***	***Long, E 22,82517***
Station PSh	***Station PSh***	***Station PSh***			
1	13,033	34,893			
10	13,046	34,914			
20	9,626	35,075			
30	7,437	35,144			
40	6,778	35,184			
50	6,527	35,192			
60	6,442	35,199			
70	6,359	35,203			
80	6,336	35,216			
90	6,226	35,213			
100	6,115	35,205			
110	6,049	35,205			
120	5,97	35,205			
130	5,834	35,194			
140	5,703	35,19			
150	5,563	35,167			
160	5,449	35,158			
170	5,433	35,165			
180	5,392	35,166			
190	5,409	35,175			
200	5,37	35,177			
210	5,325	35,176			
220	5,368	35,188			
230	5,325	35,189			
240	5,285	35,192			
250	5,258	35,193			
260	5,241	35,196			
270	5,207	35,198			
280	5,131	35,197			
290	5,102	35,203			
300	4,962	35,205			
310	4,822	35,195			
320	4,712	35,195			
330	4,595	35,184			
340	4,542	35,185			
350	4,378	35,179			
360	4,248	35,178			
370	4,186	35,173			
380	4,144	35,171			
390	4,121	35,172			
400	4,074	35,169			

Station PSh -5160		***Date 12.08.2004***	***Time 18:24***	***Lat., N 71,23283***	***Long, E 28,73267***
Station PSh	***Station PSh***	***Station PSh***			
2	12,115	34,586			
10	11,269	34,536			
20	9,236	34,48			
30	8,448	34,572			
40	7,868	34,608			
50	7,465	34,671			
60	7,297	34,75			
70	6,388	34,681			
80	6,166	34,76			
90	6,169	34,816			
100	6,626	34,981			
110	6,031	34,935			
120	6,204	35,013			
130	6,281	35,045			
140	6,082	35,083			
150	6,198	35,148			
160	6,159	35,154			
170	5,98	35,153			
180	5,914	35,163			
190	5,89	35,179			
200	5,706	35,17			
210	5,701	35,171			
220	5,661	35,177			
230	5,603	35,178			
240	5,544	35,175			
250	5,499	35,175			
260	5,392	35,176			
270	5,256	35,178			
280	5,178	35,177			
290	5,134	35,177			
300	5,037	35,179			
310	4,971	35,177			
320	4,805	35,17			
330	4,75	35,172			
340	4,664	35,168			
350	4,525	35,154			
360	4,363	35,145			
370	4,309	35,146			
380	4,292	35,145			
390	4,244	35,142			
400	4,23	35,142			
410	4,209	35,14			