

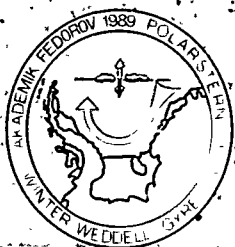
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Sea Ice Observations From the Winter Weddell Gyre Study-'89

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Debra A. Meese, John W. Govoni, Vladimír Churun, Boris Ivanov, Victor Komarovský, Vasily Shilnikov and Andre Zachek



D. A. MESE, J. W. GOVONI, A.

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February 1991



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Cover: Ice scientists measuring ice thickness in the Weddell Sea, Antarctica, during the Winter Weddell Gyre Study-'89

Special Report 91-2

Sea Ice Observations From the Winter Weddell Gyre Study-'89

Debra A. Meese, John W. Govoni, Vladimir Churun, Boris Ivanov, Victor Komarovskiy, Vasily Shilnikov and Andre Zachek

Prepared for
DIVISION OF POLAR PROGRAMS
NATIONAL SCIENCE FOUNDATION

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**US Army Corps
of Engineers**

Cold Regions Research &
Engineering Laboratory

Observations From the Winter Study-'89

Govoni, Vladimir Churun, Boris Ivanov, Victor Komarovskiy,
Zachek

February 1991



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PREFACE

This report was prepared by Dr. Debra A. Meese, Research Physical Scientist, and John W. Govoni, Physical Science Technician, of the Snow and Ice Branch, Research Division, U.S. Army Cold Regions Research and Engineering Laboratory and Vladimir Churun, Boris Ivanov, Vladimir Komarovskiy, Vasily Shilnikov and Andre Zachek of the Arctic and Antarctic Institute in Leningrad. The data for this report were obtained during the Winter Weddell Gyre Study-89 (WWGS-89) from the Soviet icebreaker *Akademik Fedorov*. The authors thank the Chief Scientist, Nikolai Bagnantsev, the captain and the crew of the *Fedorov*. Special thanks go to the ice scientists from the Arctic and Antarctic Institute in Leningrad for their support and for providing copies of their ice maps for this report.

Weekly ice extent maps were provided by the Naval Polar Oceanography Center, Department of the Navy.

This research was supported by the National Science Foundation through grant DPP#8512728.

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Report was prepared by Dr. Debra A. Meese, Research Physical Scientist, and John M. Cowan, Physical Science Technician, of the Snow and Ice Research Division, U.S. Army Cold Regions Research and Engineering Laboratory, 700 5th Avenue, Champaign, Illinois 61820. The data for this report were obtained during the Weddell Gyre Study '89 (WWGS-89) from the Soviet icebreaker *Atazhenik Fedorov*. The authors thank the Chief Scientist, Nikolai V. Vasily Shilnikov and Andre Zachek of the Arctic and Antarctic Institute in Leningrad. The authors thank the Chief Scientist, Nikolai V. Vasily Shilnikov and Andre Zachek of the Arctic and Antarctic Institute in Leningrad for providing copies of their ice maps for this report. Ice extent maps were provided by the Naval Polar Oceanography Center, Department of the Navy. Research was supported by the National Science Foundation through grant DPP-8512728. Contents of this report are not to be used for advertising or promotional purposes. Citation of brand names does not constitute an official endorsement or approval of the use of such commercial products.

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Sea Ice Observations From the Winter Weddell Gyre Study-'89

DEBRA A. MEESE, JOHN W. GOVONI, VLADIMIR CHURUN, BORIS IVANOV,
VICTOR KOMAROVSKIY, VASILY SHILNIKOV AND ANDRE ZACHEK

INTRODUCTION

The data for this report were obtained during the Winter Weddell Gyre Study-'89 (WWGS-89) from the Soviet icebreaker *Akademik Fedorov*. This study took place between September and November 1989 in the Weddell Sea, Antarctica. Several times each day throughout the cruise, we took notes on the ice conditions that the ship was passing through at that time. These notes included ice concentration, thickness, ice type, amount of ridging, number of icebergs in the area and other distinguishing characteristics. In addition, photos of the area were taken and are included in the next section.

During the cruise a Soviet ice scientist was stationed on the bridge 24 hours a day to compile detailed ice observation maps. These maps contain information for every mile of ice that was passed through during the cruise, including ice thickness, type and concentration, iceberg size, number and type, and the extent and size of leads. A following section consists of copies of these maps.

Every 30-60 miles during the cruise we would stop for an ice station where ice cores and water samples were taken for physical and chemical studies, ice thickness grids were drilled, and optical measurements were made. At each site Dr. Shilnikov from the Arctic and Antarctic Institute compiled an ice map of the station, including wind direction and speed, air temperature, ice type, ice thickness and other characteristics of the area. Copies of these maps are found in the *Ice Station Maps* section.

Also presented here are daily satellite photos of the area the ship was traversing. Throughout the cruise these photos provided the ship's crew with information regarding ice conditions that the ship would be encountering.

The final section consists of weekly ice extent maps of the Weddell Sea obtained from the National Oceanographic and Atmospheric Administration (NOAA) upon our return to the U.S.

This report contains a complete observational analysis of the ice conditions encountered during this study in the Weddell Sea.

ICE LOG AND PHOTOGRAPHS

17 September 1989 (day 260) 1100 hours

57° 20' 66" S, 37° 20' 67" W

Heading 159

First icebergs visible



Figure 1. Tabular iceberg on 17 September

18 September 1989 (day 261)

0921 hours

58° 53' 53" S, 36° 07' 97" W

Heading 213.7

No ice visible yet

1833 hours

Still no ice. Ice edge appears to be retreating faster than we are moving. We have begun collecting water samples at the surface, 50 and 100 m depths for major ion analyses.

2300 hours

58° 48' 34" S, 35° W

Hit ice edge. No pancake fields visible. Thin ice 15-30 cm thick.

19 September 1989 (Day 262) 0900 hours

60° 59' 54" S, 33° 36' 71" W

Heading 131

90% ice concentration - 50% older, thicker ice. 10% open with new ice.

60 cm thick. Algae in all first-year ice almost to the snow line.

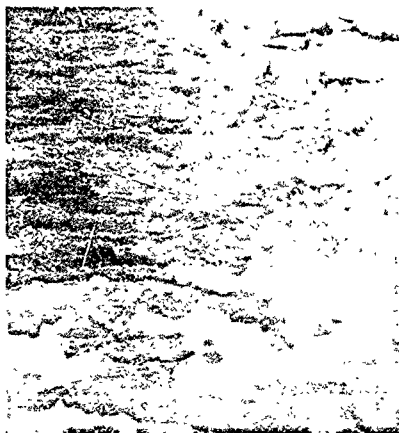


Figure 2. Wide expanse of ice on 19 September

Sea Ice Observations From the Winter Weddell Gyre Study-'89

DEBRA A. MEESE, JOHN W. GOVONI, VLADIMIR CHIRUN, BORIS F. ANON,
VICTOR KOMAROVSKIY, VASILY SHILNIKOV AND ANGE ZACHAR

18 September 1989 (day 261)

0921 hours

58° 53.53' S, 36° 07.97' W

Heading 213.7.

No ice visible yet.

1833 hours

Still no ice. Ice edge appears to be retreating faster than we are moving because of winds. We have begun collecting water samples at the surface, 50- and 100-m depths for chlorophyll-a, nutrient and major ion analyses.

2300 hours

58° 48.34' S, 35° W

Hit ice edge. No parseable fields visible. Thin ice 15-30 cm thick.

19 September 1989 (Day 262) 0500 hours

60° 59.54' S, 33° 36.71' W

Heading 131.

90% ice concentration. Ice edge retreating 10% open with new ice forming. First-year ice is 10-60 cm thick. Algae in all first-year ice adjacent to the snow line.

during the Winter Weddell Gyre Study-'89 (WWGS-89) *Fedorov*. This study took place between September and Antarctica. Several times each day throughout the cruise, we ship was passing through at that time. These notes included amount of ridging, number of icebergs in the area and other photos of the area were taken and are included in the next

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photos of the area the ship was traversing. Throughout the w with information regarding ice conditions that the ship

ice extent maps of the Weddell Sea obtained from the Administration (NOAA) upon our return to the U.S. tional analysis of the ice conditions encountered during



Large iceberg on 17 September



Figure 1. View of the ice edge on 19 September

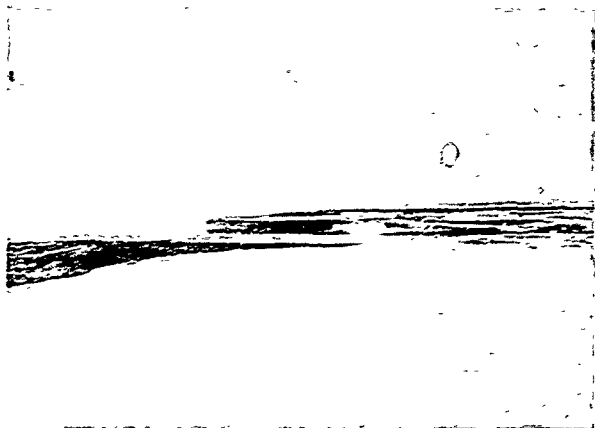


Figure 3. Ice concentration of 90% on 19 September.

20 September 1989 (day 263) 0630 hours

62° 11.11' S, 31° 16.16' W

Heading 117.1.

Foggy with blowing snow. Following lead, ice varies from thick, older ice (20 cm) with 10-50 cm snow (with a lot of algae) to thinner ice of 2-10 cm with 2-5 cm snow. Very rapid changes between thin, new ice and very thick, older ice, with equal amounts of snow and ice. Large leads in area. Ice balls of all sizes in open leads.



Figure 4. Ice balls in a lead on 20 September

21 September 1989 (day 264)

1125 hours

63° 38.69' S, 28° 30.65' W

Heading 94

Small ridges following open lead. 90% ice concentration (50-150 cm), 5% open water, 5% thin new ice, refrozen leads 3-4 cm thick. Algae present in bottom layers of thicker ice. Some of the thicker ice contains no visible layers. Snow cover is 30-50 cm thick.

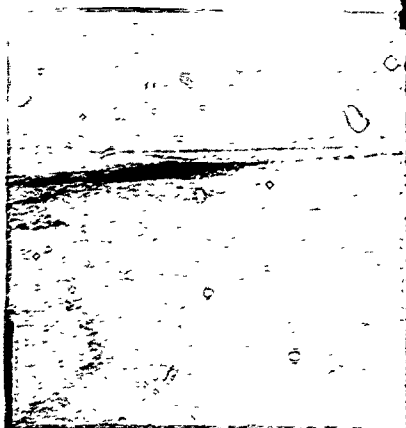


Figure 5. Ice concentration of 90% on 21 September

1245 hours

63° 48.03' S, 28° 15.45' W

Ice is 1 m thick with 20 cm of snow. Very little algae present.

23 September 1989 (day 266) 1130 hours

66° 18.61' S, 23° 33.50' W

Heading 156.3.

Ice is 30 cm to 1 m thick, with visible layers. Not as much algae as previous. Snow that is very compact. Going through area of extensive ice.

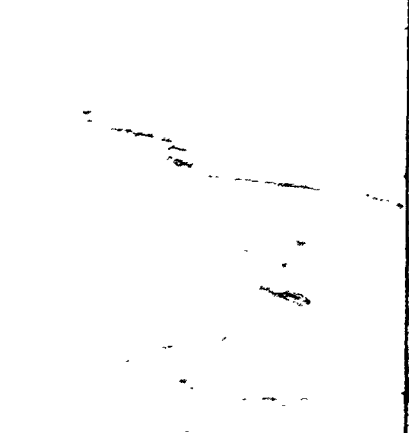


Figure 6. Ridges and leads in the ice pack.

24 September 1989 (day 267)

67° 26.000' S, 20° 59.04' W

99% concentration. Some small ridges. Ice is 1 m thick. Heavy ridging.

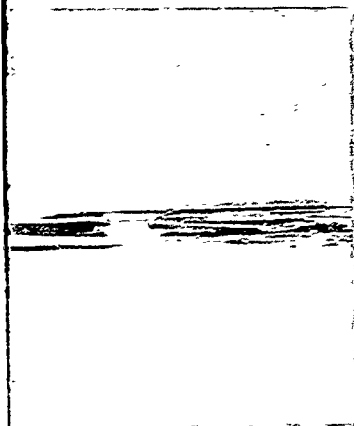


Figure 4. Ice concentration of 90% on 19 September.

ers

Ice varies from thick, older ice (20 cm) with 10-50 cm of snow to 10 cm with 2-5 cm snow. Very rapid changes between unequal amounts of snow and ice. Large leads in area. Ice

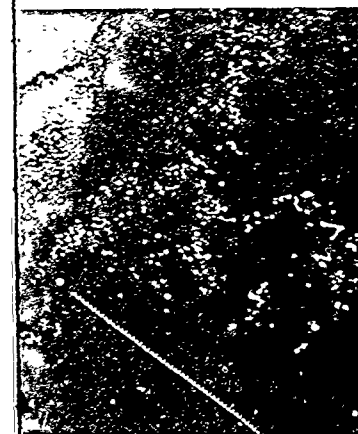


Figure 5. Ice concentration on a lead on 20 September

Ice concentration (50-150 cm), 5% open water, 5% thin. Ice is present in bottom layers of thicker ice. Some of the snow cover is 30-50 cm thick



Figure 6. Ice concentration of 90% on 21 September.

1245 hours

63° 48.03' S, 28° 15.45' W

Ice is 1 m thick with 20 cm of snow. Very little algae present. Ice has many visible layers

23 September 1989 (day 266) 1130 hours

66° 18.61' S, 23° 33.50' W

Heading 156.3.

Ice is 30 cm to 1 m thick, with visible layers. Not as much algae as previously seen. 20-30 cm of snow that is very compact. Going through area of extensive leads and ridging



Figure 7. Ridges and leads in the ice pack on 23 September

24 September 1989 (day 267)

67° 26.000' S, 20° 59.04' W

99% concentration. Some small ridges. Ice thickness approximately 80 cm. Coming into area of heavy ridging



Figure 7. Small ridges on 24 September.

25 September 1989 (day 268)

1300 hours

67° 51' 71" S, 18° 47' 75" W

100% concentration. 5-10 cm snow, 40-50 cm ice. Fairly heavy ridging. Snow and ice thickness increasing to approximately 50-70 cm ice and 40 cm snow

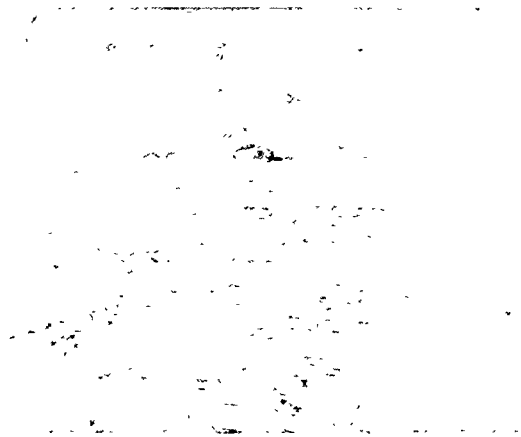


Figure 8 Ice concentration of 100% on 25 September

1700 hours

67° 50' 24" S, 18° 23' 98" W

70% concentration 20% new leads, 10-20% breccia 10-20 cm snow and 10-60 cm ice 40% ridges

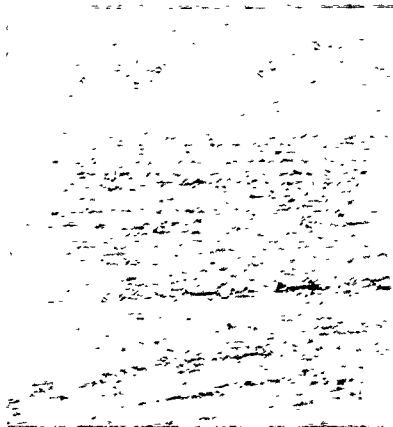


Figure 9. Ice concentration of 70% on 25 September

26 September 1989 (day 269) 1130 hours

67° 41.82' S, 17° 13' 99" W

100% ice concentration Snow 10-20 cm, ice 40-50 cm. Some ridging

27 September 1989 (day 270)

0900 hours

67° 18.07' S, 14° 58' 70" W

95% concentration. Floes are approximately 1 km with ridging in between. Little visible algae

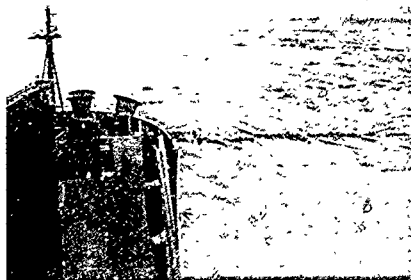


Figure 10 Ice concentration of 95% with ridges between floes



ridges on 24 September.

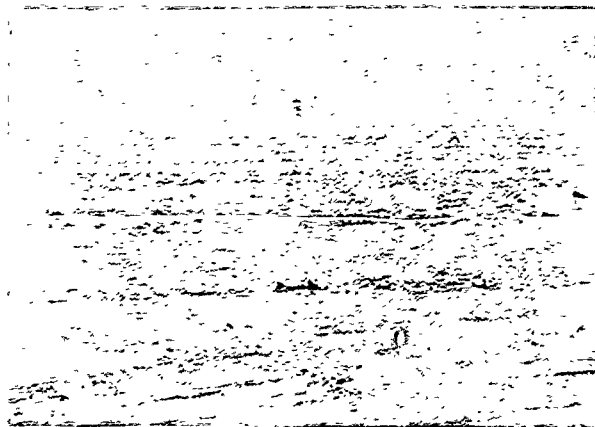


Figure 9 Ice concentration of 70% on 25 September.

26 September 1989 (day 269) 1130 hours

67° 41' 82" S, 17° 13' 99" W

100% ice concentration Snow 10–20 cm, ice 40–50 cm Some ridged areas

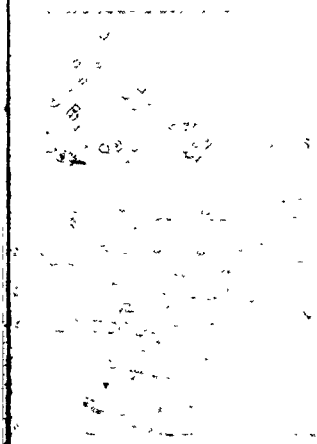
9 cm ice Fairly heavy ridging Snow and ice thickness and 40 cm snow.

27 September 1989 (day 270)

0900 hours

67° 18' 07" S, 14° 58' 70" W

95% concentration Floes are approximately 1 km with ridging in between 10–60 cm snow and 10 cm to 1 m of ice Little visible algae



ation of 100% on 25 September

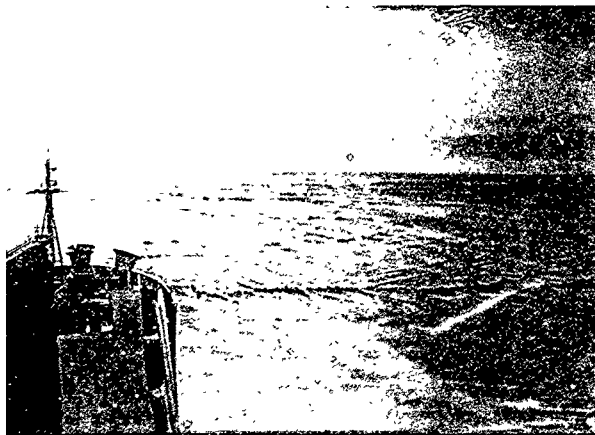


Figure 10 Ice concentration of 95% with ridges between floes on 27 September

braccia 10–20 cm snow and 10–60 cm ice 40% ridges

1800 hours

67° 07.91' S, 13° 30.12' W

98% concentration. Snow is 20–40 cm, ice is 50 cm to 1 m. Heavily ridged area. Newly formed pancakes in lead.

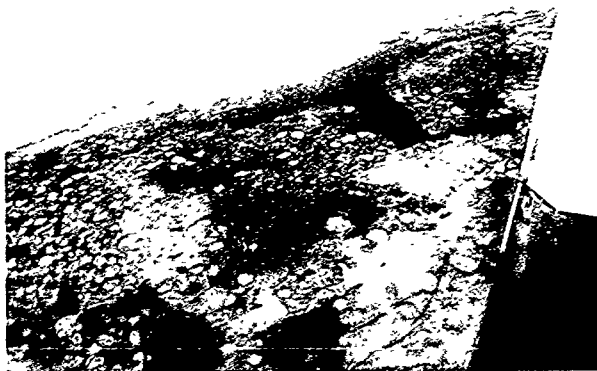


Figure 11 Newly formed pancakes in lead on 27 September



Figure 12 Heavily ridged area on 27 September

28 September 1989 (day 271)

0845 hours

66° 52' 10" S, 11° 27' 94" W

Foggy, visibility 100–200 m. Thin first year ice, 20–30 cm. Snow is 20–30 cm. Ice is layered, no visible algae.

1820 hours

66° 38' 21" S, 10° 11' 14" W

99% concentration. Snow is approximately 20–30 cm thick and the ice is 60–70 cm. New first-year ice. 25% ridged and brecciated. One berg visible.

29 September 1989 (day 272)

1515 hours

66° 19.05' S, 07° 40.15' W

Ice is 60–70 cm with 0–20 cm of snow. Little visible algae. Folio cm and very ridged.



Figure 13 Following lead on 29 September

1940 hours

66° 10' 48" S, 06° 44' 36" W

Concentration is 80%. Ice is 50 cm to 1 m thick. Snow is compact.

30 September 1989 (day 273)

0954 hours

65° 59' 88" S, 04° 54' 78" W

Ice concentration is 60% thick ice. All leads have 2–10 cm of ice. Floes are 50 cm to 1 m with 20–30 cm of snow. 10–20% ridged.



Figure 14 Lead with new ice on 30 September

29 September 1989 (day 272)

1515 hours

66° 19.05' S, 07° 40.15' W

Ice is 60-90 cm with 0-20 cm of snow. Little visible algae. Following lead. First-year ice is 10-20 cm and very ridged.

ice is 50 cm to 1 m. Heavily ridged area. Newly formed



formed pancakes in lead on 27 September



Figure 13 Following lead on 29 September

1940 hours

66° 10.48' S, 06° 44.36' W

Concentration is 80% Ice is 50 cm to 1 m thick. Snow is compact and between 40-60 cm

30 September 1989 (day 273)

0954 hours

65° 59.88' S, 04° 54.78' W

Ice concentration is 60% thick ice. All leads have 2-10 cm of ice with 10% open patches. Thicker floes are 50 cm to 1 m with 20-30 cm of snow. 10-20% ridging. Have been following leads



with ridged area on 27 September

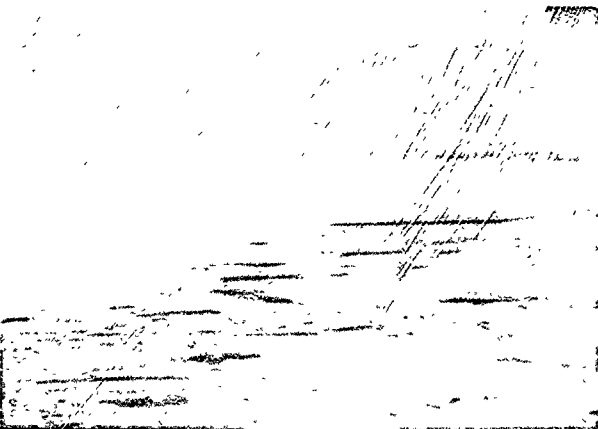


Figure 14 Lead with new ice on 30 September

ice is 50 cm to 1 m. Heavily ridged area. Newly formed

ice 20-30 cm thick and the ice is 60-70 cm. New first-year ice visible

1252 hours

65° 52.08' S, 04° 20.24' W

Visibility poor because of fog and blowing snow. Ice thickness ranges from 60 cm to 1 m. Snow is 20–40 cm and is compact. Small lead visible from ship, otherwise no open water.

1719 hours

65° 45.45' S, 03° 32.15' W

Poor visibility. Ice concentration is approximately 100%. Ice is 50–70 cm thick and snow is 0–10 cm thick.

1 October 1989 (day 274)

1033 hours

65° 24.17' S, 01° 14.69' W

Approx. concentration. Thin first-year ice of 10–20 cm. Snow is 1–5 cm thick. Light ridging in area

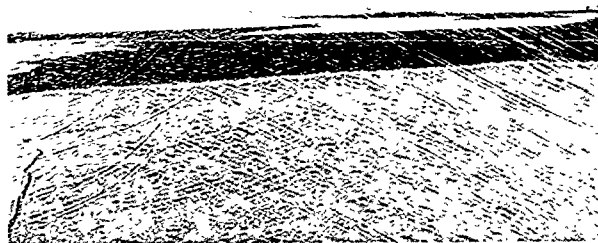


Figure 15 Thin first-year ice and leads on 1 October 1989

1630 hours

65° 16.62' S, 00° 35.71' W

Following leads 70% ice concentration. Ten or more bergs visible. Thin first-year ice of 5–30 cm with 2–5 cm snow. Some minor ridging.



Figure 16 Ice bergs visible in area on 1 October

2 October 1989 (day 275)

1251 hours

65° 02.45' S, 02° 46.19' E

90% concentration. Thick ice of 50–90 cm with 30 cm snow. Thick at the bottom. Pancake ice in leads. Two bergs visible.

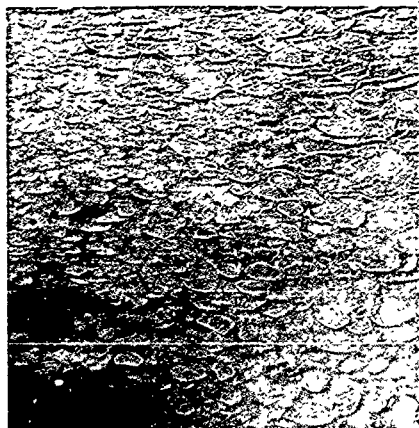


Figure 17 Pancake ice in lead on 2 October

1325 hours

65° 05.23' S, 02° 37.79' E

60% concentration. Following leads

1525 hours

65° 21.29' S, 02° 13.55' E

90% concentration. Young ice between 30–40 cm with 0–5 cm snow. Ice visible

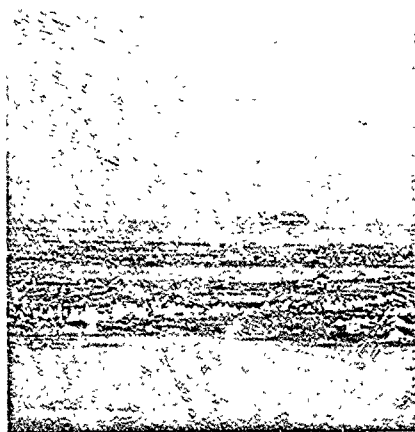


Figure 18 Brecciated, ridged ice on 2 October

2 October 1989 (day 275)

1251 hours

65° 02' 45" S, 02° 46.19' E

90% concentration Thick ice of 50-90 cm with 30 cm snow. Thicker ice has a 10-cm algal layer at the bottom. Pancake ice in leads Two bergs visible

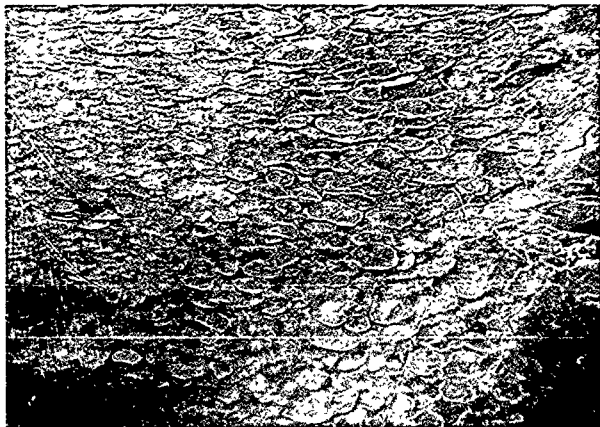


Figure 17 Pancake ice in lead on 2 October

1325 hours

65° 05' 23" S, 02° 37' 79" E

60% concentration Following leads

1525 hours

65° 21' 29" S, 02° 13' 55" E

90% concentration Young ice between 30-40 cm with 0-5 cm snow Very brecciated Four bergs visible



Figure 18 Brecciated ridged ice on 2 October

Ice thickness ranges from 60 cm to 1 m. Snow is 1-5 cm thick. No open water.

Ice is 50-70 cm thick and snow is 0-5 cm thick.

Ice is 1-5 cm thick. Light ridging in area.

Ice and leads on 1 October 1989

One or more bergs visible Thin first-year ice of 5-30 cm

Bergs visible in area on 1 October

1845 hours

65° 26.99' S, 01° 53.59' E

95% concentration Heavily ridged area. Ice is approximately 60–70 cm with 5–10 cm snow. Ten bergs visible.

3 October 1989 (day 276)

0930 hours

66° 18.99' S, 00° 17.67' W

Heading 217

85% concentration Mostly thin, new ice of 5–10 cm with 1 cm snow. Thicker ice is brecciated (approximately 30%). Four icebergs visible.



Figure 19 Thin, new ice surrounded by older, brecciated ice on 3 October

1740 hours

66° 33.53' S, 00° 52.98' W

In storm, visibility poor. For approximately the last hour have been going through open water or very thin ice. Now in ice 30–40 cm with 5 cm snow. Some ridging and leads visible.

4 October 1989 (day 277)

0750 hours

66° 31.68' S, 01° 54.13' W

Heading 346

95% concentration Young first-year ice of 30–40 cm with 2–5 cm snow. Approximately 30% ridged. One berg visible.

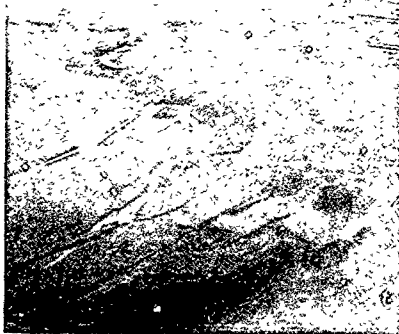


Figure 20 Thin first-year ice with extensive ridging

1430 hours

66° 05.82' S, 02° 02.00' W

Heading 336

90% concentration Thick ice of 60–80 cm with 40–50 cm snow with 10 cm snow. More algae visible here than seen in the last two leads.

5 October 1989 (day 278) 1640 hours

65° 11.62' S, 02° 07.94' W

Heading 214

80% concentration Thick, ridged ice of 1–2 m in places of 1–2 cm up to 10–30 cm with 5 cm snow.

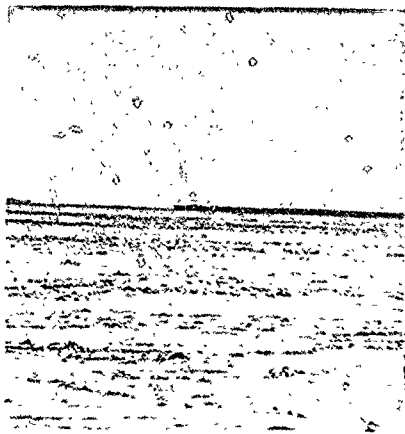


Figure 21 Large, tabular iceberg on 5 October

approximately 60-70 cm with 5-10 cm snow. Ten

ice of 5-10 cm with 1 cm snow. Thicker ice is brecciated
visible



Figure 19 Brecciated ice on 4 October

ice surface is brecciated through open water (or very
some ridging and leads visible

ice of 30-40 cm with 2-5 cm snow. Approximately 30%



Figure 20 Thin first-year ice with extensive ridging on 4 October

1430 hours

66° 05' 82" S, 02° 02' 00" W

Heading 336

90% concentration. Thick ice of 60-80 cm with 40-50 cm snow. Thin ice near leads of 30-40 cm with 10 cm snow. More algae visible here than seen in the last couple of days. Some pancakes in leads.

5 October 1989 (day 278) 1630 hours

65° 11' 62" S, 02° 07' 94" W

Heading 294

80% concentration. Thick, ridged floes of 1-2 m with 10 cm of snow, surrounded by thin, new ice of 1-2 cm, up to 10-16 cm with 5 cm snow.

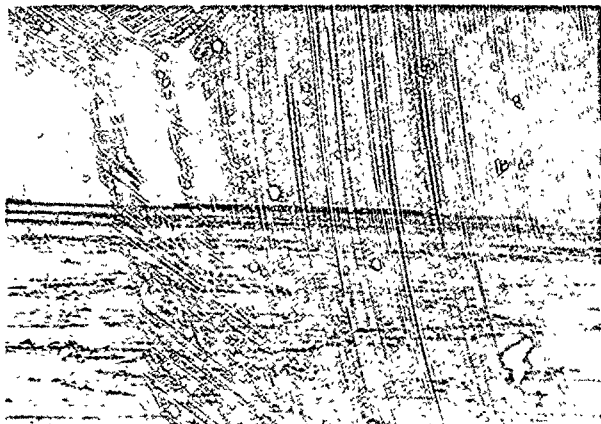


Figure 21 Large tabular iceberg on 5 October

6 October 1989 (day 279)

0830 hours

65° 42' 47" S, 01° 57' 42" W

Heading 135.8

100% concentration. Ice is 40 cm to 1 m with 10–30 cm snow. Approximately 60% is ridged or brecciated.

1100 hours

65° 46' S, 01° 50' W

Arrive at mesopolygon

7 October 1989 (day 280)

0900 hours

65° 52' 01" S, 01° 51' 50" W

Heading 153

Foggy, no horizon, visibility bad

1617 hours

65° 56' 88" S, 01° 50' 60" W

Heading 156.6

On station since 1030. Large cracks and leads opening up port and starboard. Large lead from stern around port side.

8 October 1989 (day 281), 1440 hours

66° 04' 02" S, 02° 02' 45" W

Foggy, windy. Visibility very poor. Cannot see leads.

9 October 1989 (day 282)

0830 hours

65° 59' 85" S, 02° 28' 45" W

Storm is over, sunny day. Leads surrounding ship between 1 and 1.5 km.

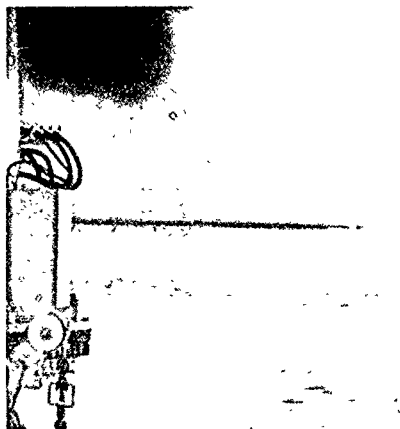


Figure 22. Mesopolygon after storm on 9 October. Many leads had opened up around the ship.

1945 hours

66° 05' 20" S, 02° 35' 49" W

No visible changes

10 October 1989 (day 283)

0900 hours

66° 11' 39" S, 02° 49' 78" W

Overcast. Leads appear to be closing somewhat, but difficult to judge.

2100 hours

66° 14' 03" S, 02° 57' 91" W

Crack from bow to lead on starboard side opened at noon. Everything flapping. Opening that are not visible because of thick snow. Crack opened from the way to the lead behind the ship.

11 October 1989 (day 284)

0815 hours

66° 16' 96" S, 03° 03' 13" W

Crack from bow to lead on starboard side is larger (approximately 20 m). Causing it to refreeze. Ice floe starting to close up CTD hole. May have

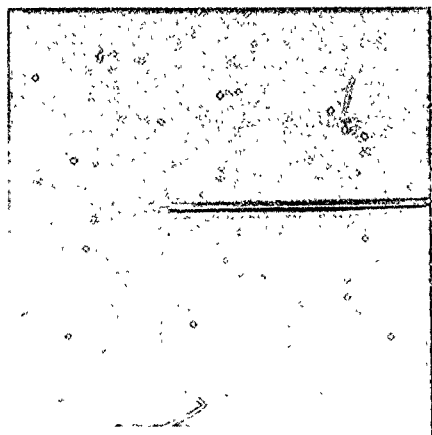


Figure 23. Leads surrounding ship on 11 October.

1930 hours

66° 21' 11" S, 03° 28' 84" W

No visible changes

12 October 1989 (day 285)

0820 hours

66° 14' 28" S, 03° 55' 09" W

Visibility poor. Ship has moved 20 m from last night. Ice broken up, drifted in. Will be difficult to work on ice.

1945 hours

66° 05' 20" S, 02° 35.49' W
No visible changes

10 October 1989 (day 283)

0900 hours

66° 11' 39" S, 02° 49.78' W
Overcast. Leads appear to be closing somewhat, but difficult to judge after snowfall last night.

2100 hours

66° 14' 03" S, 02° 57' 91" W
Crack from bow to lead on starboard side opened at noon. Everything flooding and very wet. Cracks opening that are not visible because of thick snow. Crack opened from stern of ship on port side all the way to the lead behind the ship.

11 October 1989 (day 284)

0815 hours

66° 16' 96" S, 03° 03' 13" W
Crack from bow to lead on starboard side is larger (approximately 20 m wide). Snow blowing in is causing it to refreeze. Ice floe starting to close up CTD hole. May have to move ship. Visibility poor.

ds opening up port and starboard. Large lead from stern

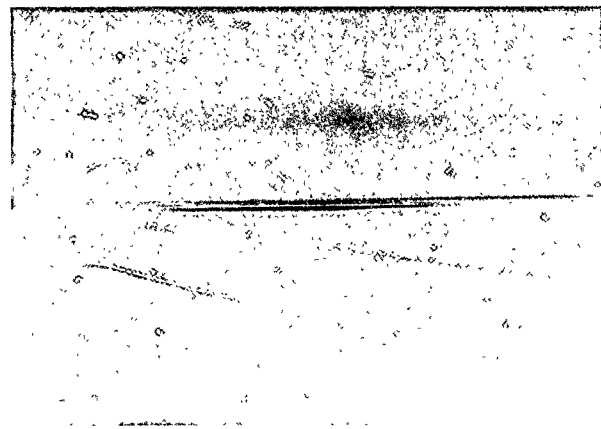


Figure 23 Leads surrounding ship on 11 October

1930 hours

66° 21' 11" S, 03° 28' 84" W
No visible changes

12 October 1989 (day 285)

0820 hours

66° 14' 28" S, 03° 55' 09" W
Visibility poor. Ship has moved 20 m from last night. Ice broken up around ship. Everything has drifted in. Will be difficult to work on ice.

October Many leads had opened up around the ship

1545 hours

66° 10.75' S, 04° 03.06' W

Visibility has improved. More open water around us than before the storm. Leads and cracks covered with snow and impossible to distinguish from thick ice. All ice is more flooded than yesterday.



Figure 24. Frozen footprints in slush from flooding of ice surface on 12 October.

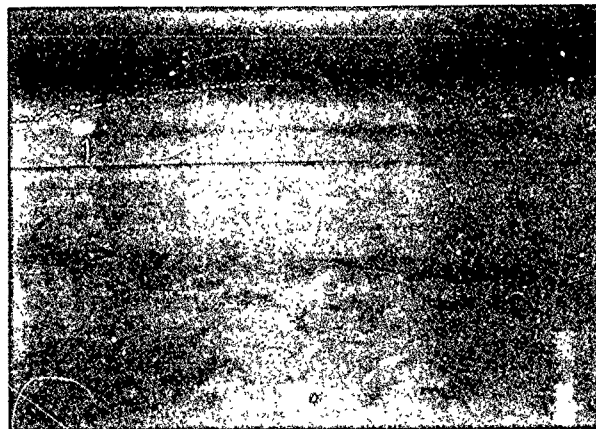


Figure 25. Leads covered with snow, indistinguishable from surrounding ice on 12 October.

13 October 1989 (day 286)

0820 hours

66° 04.71' S, 04° 11.89' W
Heading 146.1.

Wind has dropped and breakup seems to have stopped

1858 hours

66° 00.13' S, 04° 12.16' W

Not much change since this morning. Ice and snow hardening up. Snow bridges over cracks. Difficult to determine what's what.

14 October 1989 (day 287)

0845 hours

65° 56.13' S, 04° 12.98' W

Sunny day. Ice conditions did not change much over night. Six



Figure 26. Six icebergs within sight of the ship

2053 hours

65° 52.4' S, 04° 18.89' W
Heading 149.4.
No visible changes.

15 October 1989 (day 288)

0815 hours

65° 49.38' S, 04° 19.17' W
Clear with low ground fog. Some new cracks in the ice on stern and around port side, approximately 0.5 to 1 km from ship.

1840 hours

65° 44.28' S, 04° 16.54' W
Heading 147.3.

Ice conditions have not changed much during the day. Lead

16 October 1989 (day 289)

0830 hours

65° 35.98' S, 04° 18.77' W
Heading 146.8.

Bright sunny day. Lead on port side of ship has closed up. To the ship. Starboard side of ship has four patches of open water, from 0.5-1.5 km in size.

1730 hours

65° 31.65' S, 04° 15.00' W

No change in ice conditions since this morning

14 October 1989 (day 287)

0845 hours

65° 56.15' S, 04° 12.98' W

Sunny day. Ice conditions did not change much over night. Sea visible bergs.

around us than before the storm. Leads and cracks covered from thick ice. All ice is more flooded than yesterday.



Figure 25 Sea ice conditions around the ship on 14 October 1989



Figure 26 Sea ice conditions around the ship on 14 October 1989

2053 hours

65° 52.4' S, 04° 18.89' W

Heading 149.4

No visible changes.

15 October 1989 (day 288)

0815 hours

65° 49.38' S, 04° 19.17' W

Clear with low ground fog. Some ice cracks in the ice on the starboard side, one from the stern and around port side, approximately 0.5 to 1 km from the ship.

1840 hours

65° 44.28' S, 04° 16.54' W

Heading 147.3

Ice conditions have not changed much since the last lead on port side of ship has opened.

16 October 1989 (day 289)

0830 hours

65° 35.98' S, 04° 18.77' W

Heading 146.8

Bright sunny day. Lead on port side of ship has closed up. There seems to be a larger lead behind the ship. Starboard side of ship has a patch of open water approximately 3-4 km away that range from 0.5-1.5 km in size.

1730 hours

65° 31.65' S, 04° 15.00' W

No change in ice conditions much from last.

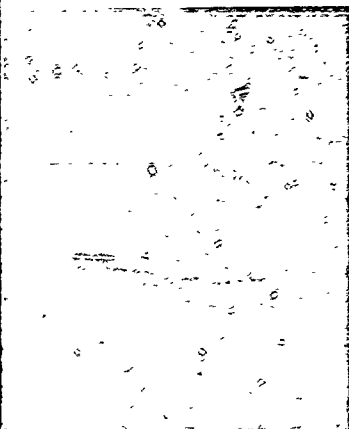


Figure 27 Sea ice conditions around the ship on 12 October 1989

Figure 28

Figure 29 Snow bridges over cracks

17 October 1989 (day 290) 0734 hours

65° 23.95' S, 04° 10.68' W

Ice conditions the same as last night. Crack on port side has ridged slightly. Ponds to stern/starboard appear to be frozen this morning. *Polarstern* on horizon.

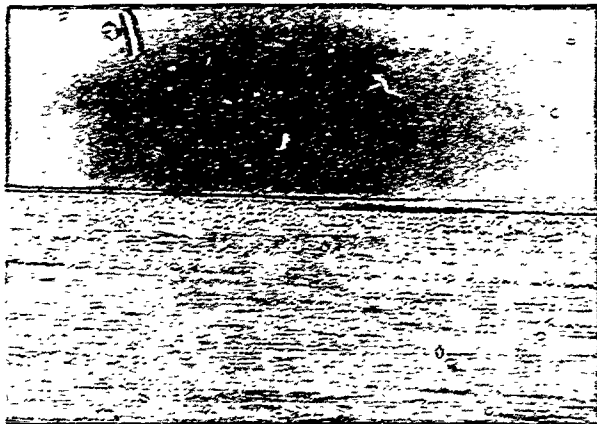


Figure 27. Frozen ponds on horizon on 17 October.

18 October 1989 (day 291)

0820 hours

65° 21.05' S, 04° 06.85' W

Heading 142.6.

Ice conditions have changed little since yesterday. Crack from starboard to outer lead has opened again. Ponds refreezing.

1550 hours

65° 25.59' S, 03° 45.32' W

Left mesopolygon at 1330 because the *Polarstern* broke up the floe when she left. 100% concentration. 85% is thick ice of 50-70 cm with 0-5 cm snow. 15% is refrozen leads of 2-15 cm. Heavy ridging covering approximately 20% of the area exists. Two bergs visible



Figure 28. Broken ice and track left by the *Polarstern* 18 October

19 October 1989 (day 292)

1230 hours

64° 44.36' S, 03° 30.13' W

Heading 298.

Foggy, visibility poor. 100% concentration. Ice is approximately 50-70 cm thick. No ridging visible.

1815 hours

64° 30.87' S, 03° 53.21' W

Heading 329.9.

70% concentration. Ice is 10-50 cm with 5-10 cm snow. Ice on bergs visible.



Figure 29. Ice concentration of 70% on 19 October

20 October 1989 (day 293)

1300 hours

63° 16.90' S, 06° 25.66' W

80% concentration. Ice is approximately 30-40 cm with 0-5 cm snow with layer of frazil—no pancakes visible



Figure 30. Ship following a frozen lead on 20 October

19 October 1989 (day 292)

1230 hours

64° 44.56' S, 03° 30.13' W

Heading 298.

Foggy, visibility poor. 100% concentration. Ice is approximately 50-80 cm with 10-30 cm snow. 10% ridging. Little algae visible.

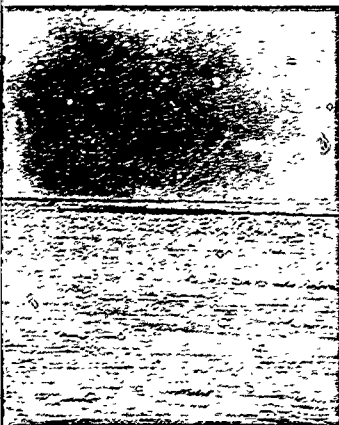
1815 hours

64° 30.87' S, 03° 53.21' W

Heading 329.9.

70% concentration. Ice is 10-50 cm with 5-10 cm snow. Ice is approximately 40% ridged. Two bergs visible.

on port side has ridged slightly. Ponds to stern/starboard on horizon.



ponds on horizon on 17 October.



Figure 29 Ice concentration of 70% on 19 October

20 October 1989 (day 293)

1300 hours

63° 16 90' S, 06° 25 66' W

80% concentration. Ice is approximately 30-40 cm with 0-5 cm snow. Leads are about 50% of area with layer of frazil—no pancakes visible

stern broke up the floe when she left. 100% concentration. 15% is refrozen leads of 2-15 cm. Heavy ice area exists. Two bergs visible



left by the Polarstern 15 October

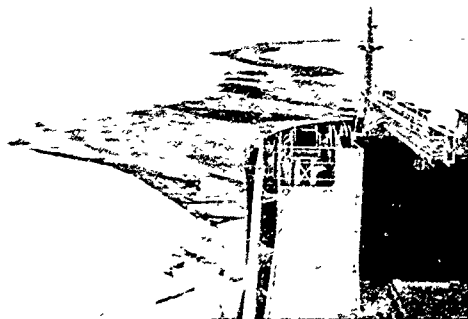


Figure 30 Ship following refrozen lead on 20 October

2050 hours

62° 53.08' S, 07° 11.40' W

Heading 346.

Snowing, visibility poor. 70% concentration. Hardest ice seen in the last two days. Ice is 40–50 cm with 5–10 cm snow.

21 October 1989 (day 294)

1005 hours

62° 06.44' S, 08° 56.36' W

Heading 330.

70% concentration. Following large leads. 5% pancakes in leads. Thick ice is 50–100 cm with 10–30 cm snow.

2013 hours

61° 26.35' S, 10° 12.72' W

Heading 345.

85% concentration. Leads have approximately 1 cm frazil—no pancakes. Ice is between 20–30 cm with 5 cm snow.

22 October 1989 (day 295)

0820 hours

61° 47.30' S, 11° 32.15' W

Heading 340.

Visibility poor because of snow. No photos. Ice is between 50 cm to 1 m with 30 cm of snow. A lot of brown color through at least the bottom half of the ice. On some ice there is a clear layer of ice below the algal layer.

1330 hours

60° 22.85' S, 11° 38.84' W

Heading 392

95% concentration. Surface algal concentration seen. Ice is between 70–100 cm with 20 cm of snow.



Figure 31 Algal layer at snow/ice interface on 22 October

23 October 1989 (day 296)

0712 hours

58° 32.80' S, 13° 16.65' W

Heading 325.

50% concentration. All broken up floes in the remaining area are from 20–100 cm. Dark algal bands in most ice.

0727 hours

More surface algae. Ice rotten at snow/ice interface and is very



Figure 32 Getting close to ice edge on 24 October. Thin layer of pancake ice in between

1714 hours

58° 09.62' S, 15° 28.78' W

Heading 283

1/2 concentration. Ice in broken pieces. Bands of ice following

24 October 1989 (day 297)

1030 hours

58° 04.73' S, 22° 57.42' W

Heading 267.5

5% concentration

1056 hours

Too many bergs to count (more than 200)

23 October 1989 (day 296)

0712 hours

58° 32.80' S, 13° 16.65' W

Heading 325.

50% concentration. All broken up floes in the remaining area are pancake ice. Range of thickness from 20–100 cm. Dark algal bands in most ice.

0727 hours

More surface algae. Ice rotten at snow/ice interface and is very dark.



Figure 32 Getting close to ice edge on 23 October. Floes are broken up into smaller pieces with pancake ice in between

1714 hours

58° 09.62' S, 15° 28' 78" W

Heading 283

3% concentration. Ice in broken pieces. Bands of ice following surface waves

24 October 1989 (day 297)

1030 hours

58° 04' 73" S, 22° 57' 42" W

Heading 267.5

5% concentration

1056 hours

Too many bergs to count (more than 200)



snow/ice interface on 22 October



Figure 33 More than 200 icebergs in area on 24 October

1615 hours

58° 03' 39" S, 24° 55' 14" W

Too many bergs to count. Ice concentration 100%. Mostly older ice and ice breccia. Incredible amounts of algae in floes and breccia. Water even looks brown in areas.

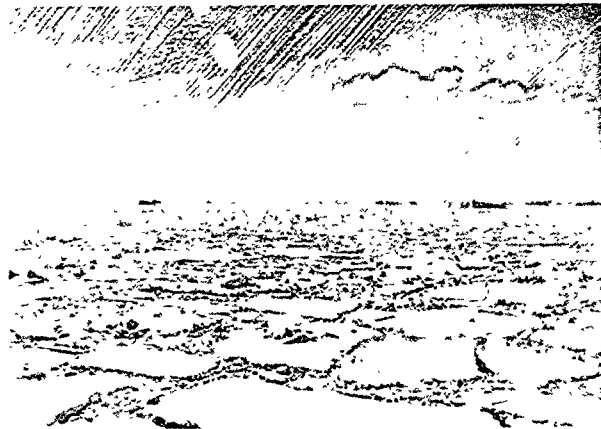


Figure 34 Older ice with ice breccia on 24 October

1702 hours

58° 03' 27" S, 25° 04' 03" W

More breccia... fewer large floes. Open water ahead. Going through large berg population now, fewer ahead.



Figure 35 Brecciated area on 24 October

1730 hours

58° 03' 02" S, 25° 08' 50" W

Swell beginning. Pancakes mixed with breccia and small floes.

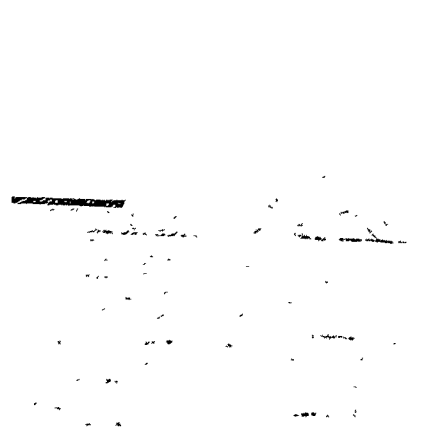
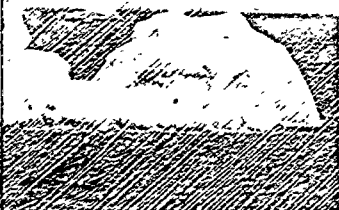


Figure 36 Iceberg near ice edge on 24 October

1730 hours

Pancake fields



00 icebergs in area on 24 October

on 100% Mostly older ice and ice breccia Incredible
to even looks brown in areas



with ice breccia on 24 October

ahead Going through large berg population now, fewer



Figure 35 Brecciated area on 24 October

1730 hours

58° 03' 02" S, 25° 08' 50" W

Swells beginning Pancakes mixed with breccia and small floes



Figure 36 Iceberg near ice edge on 24 October

1732 hours

Pancake fields



Figure 37 Pancakes at ice edge on 24 October

1733 hours

~8° 03 05' S, 25° 09 66' W

Open water

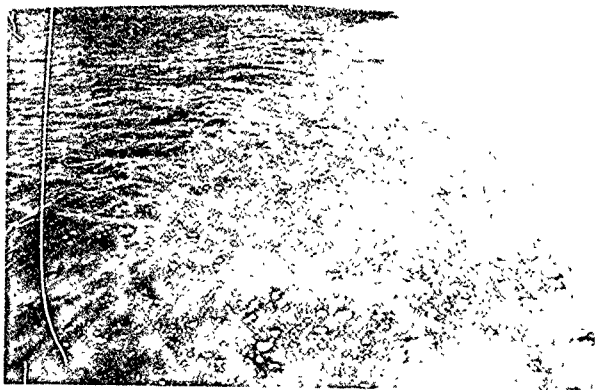


Figure 38 Ice edge, 24 October

25 October 1989 (day 298)

0816 hours

58° 41 00' S, 32 40 23' W

Heading 257 9

One iceberg, 0% ice concentration

0839 hours

One very large, tabular iceberg—10 km long and 30–35 m high

1718 hours

59° 10 93' S, 37° 12 98' W

Heading 258 3

No bergs No ice

26 October 1989 (day 299) 1210 hours

59° 10 86' S, 44° 37 45' W

Heading 250 9

No ice

27 October 1989 (day 300) 0822 hours

60° 30 30' S, 54° 00 93' W

Heading 289

No ice No bergs

The following section, provided by the Soviet ice scientists, is a continuous map of the ice conditions encountered during the cruise. A legend defining the symbols is provided as a foldout at the end of the section. Symbols define ice concentration, ice thickness characteristics and developmental stage of ice growth.

Legend on page 45.

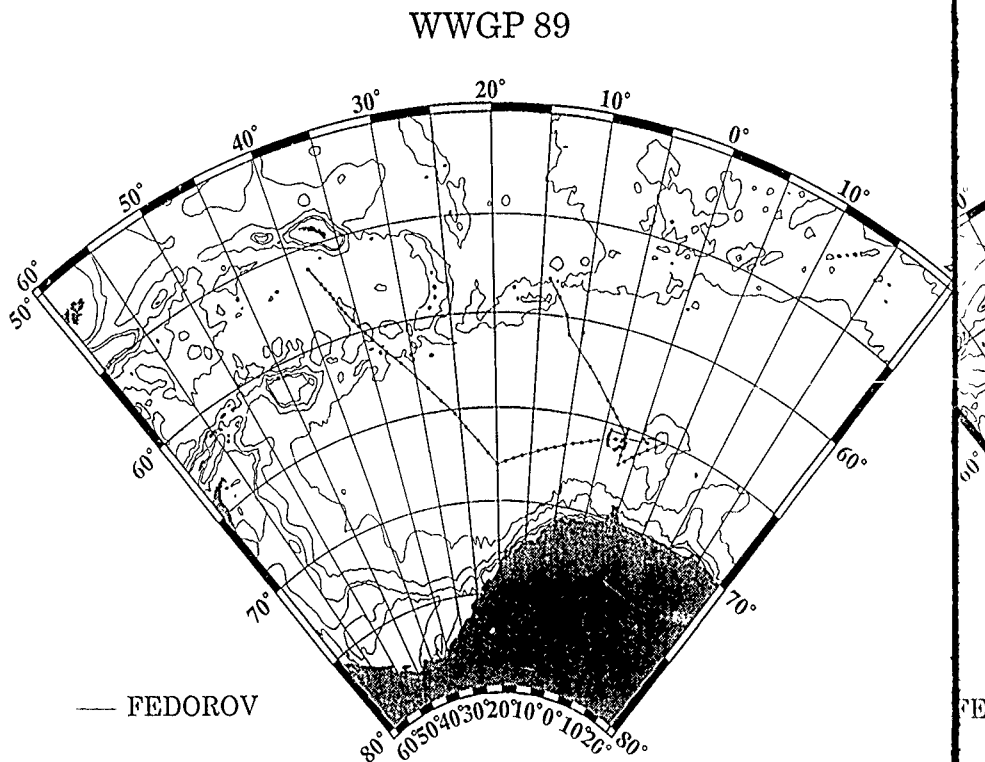
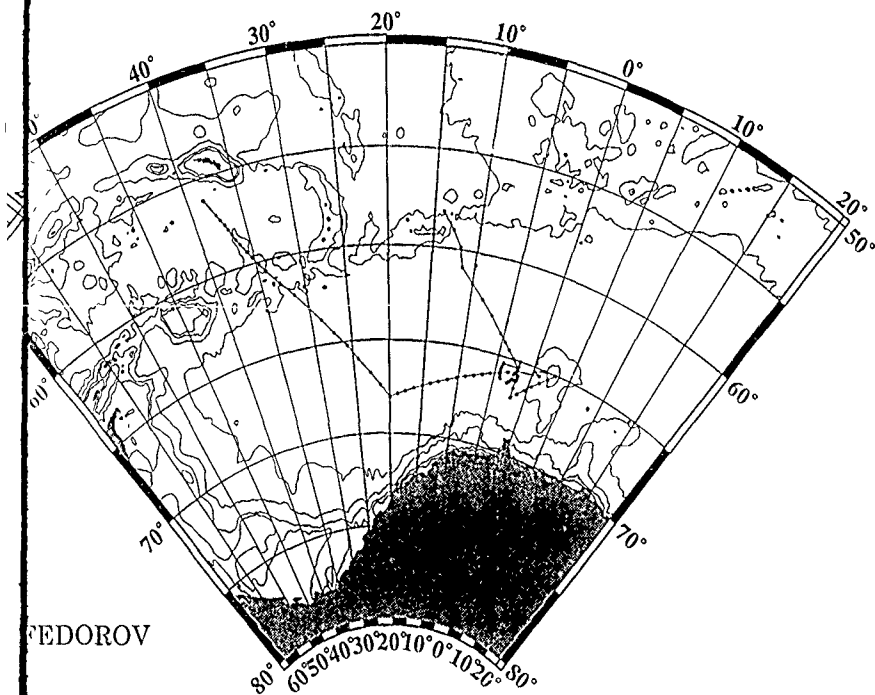


Figure 39. Fedorov's ship track. The solid line represents the track of the Fedorov CTD casts started at 56° 53' W, and we stopped taking data at 5° 37' W. Each dot represents a CTD cast and in most cases an ice station.

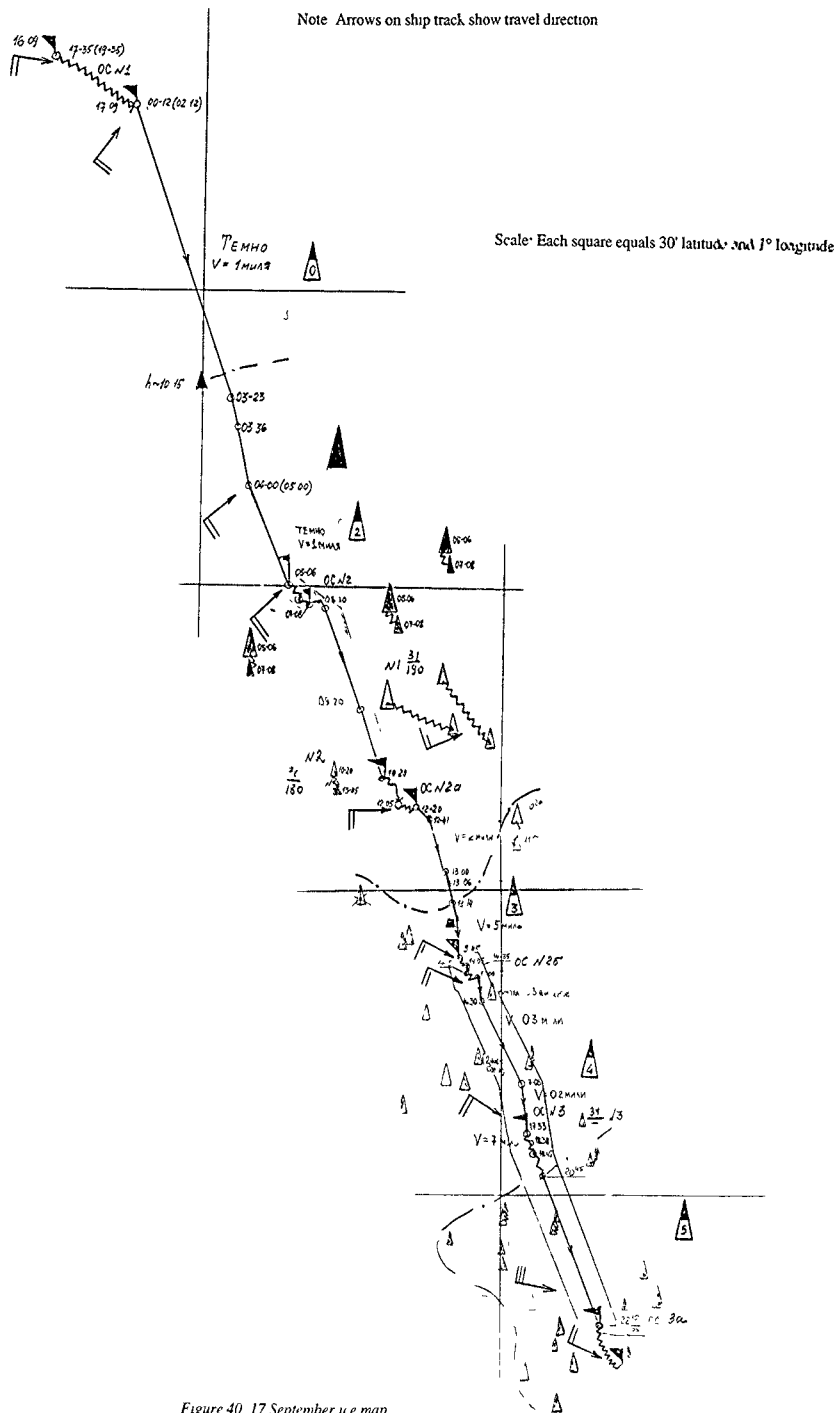
ing section, provided by the Soviet ice scientists, is a continuous map of the ice conditions encountered during the cruise. A legend
symbols is provided as a foldout at the end of the section. Symbols define ice concentration, ice thickness characteristics and
stage of ice growth

ge 45.

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ow's ship track. The solid line represents the track of the Fedorov. CTD casts started at 56°S 37°W, and we stopped taking data at 58°S 14°W
and a CTD cast and in most cases an ice station



1. 4. 2

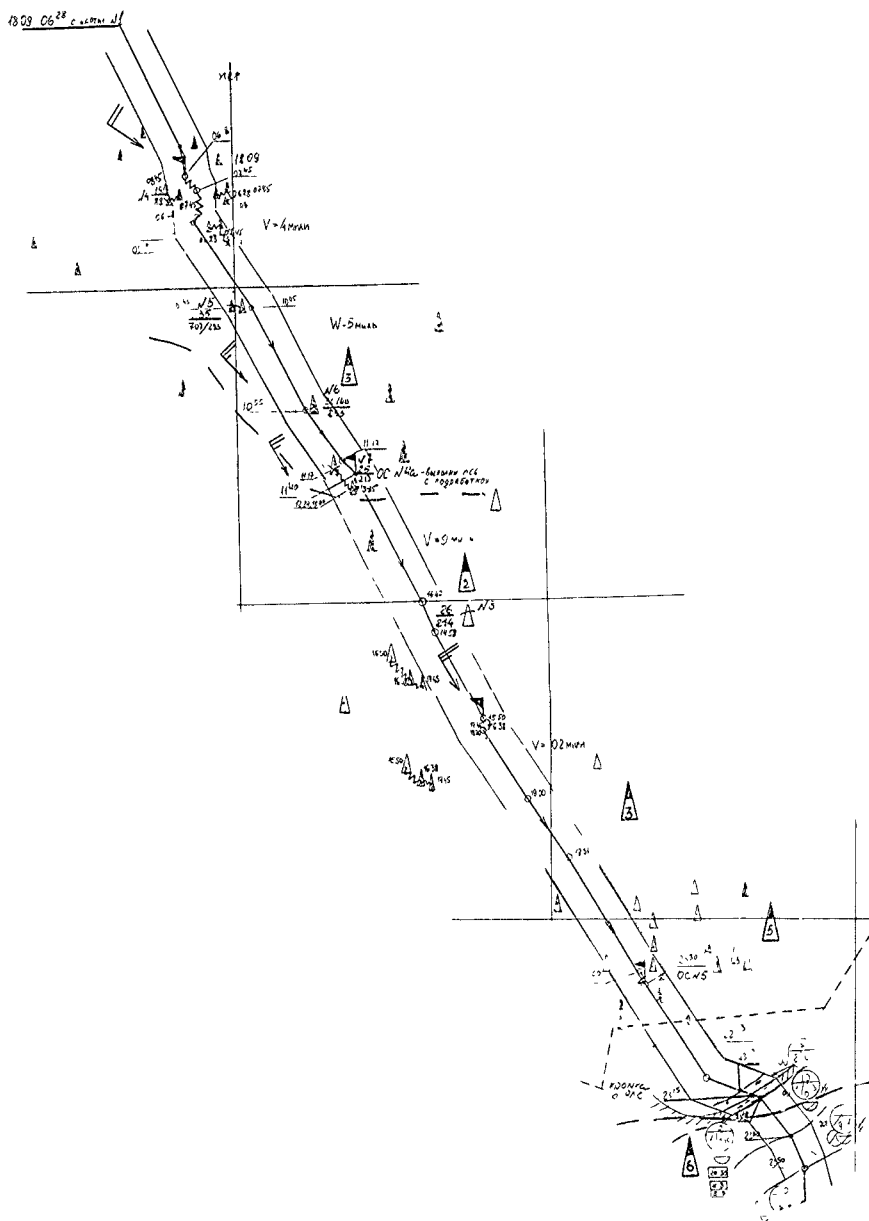
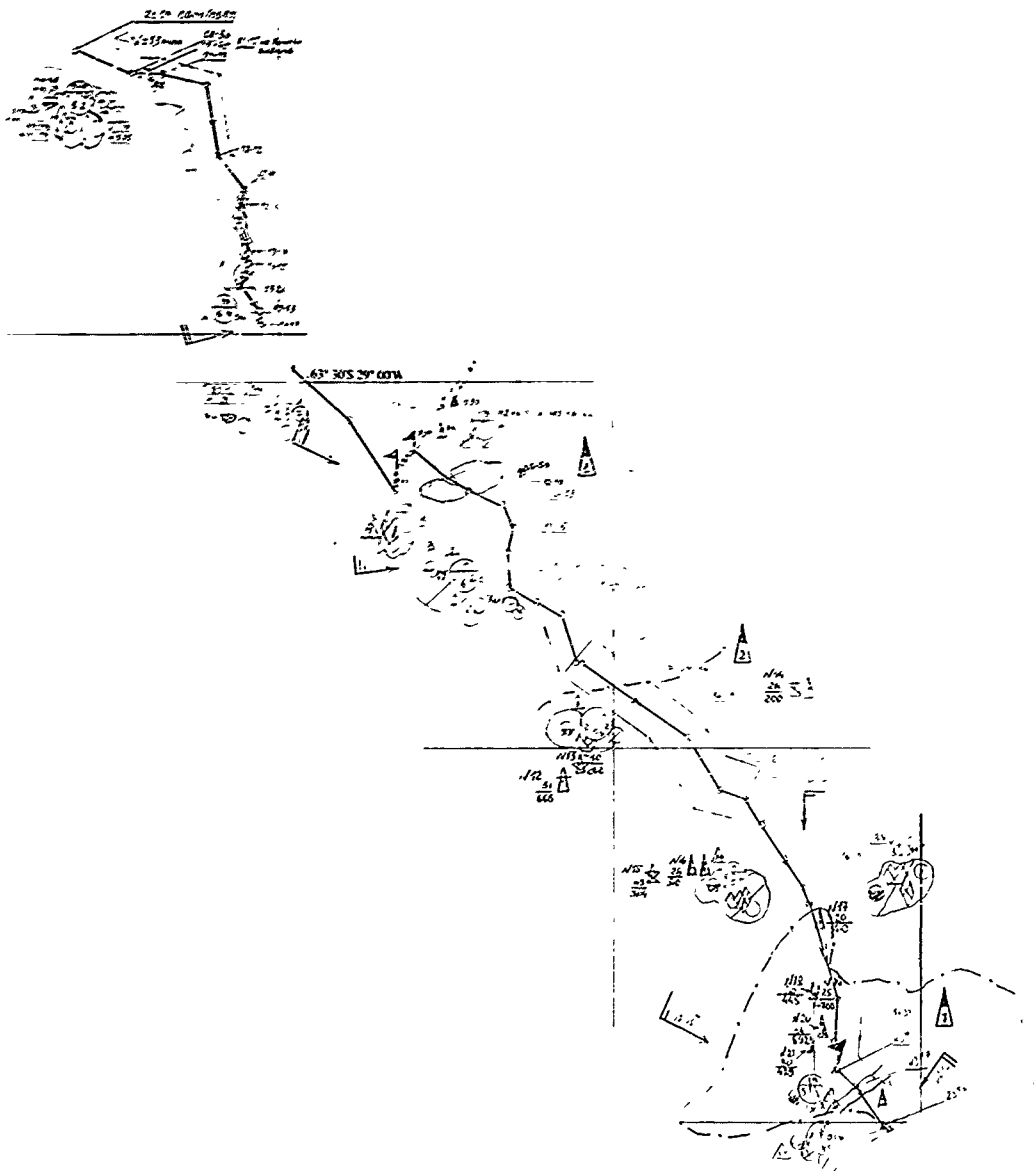


Figure 41 18 September ice map



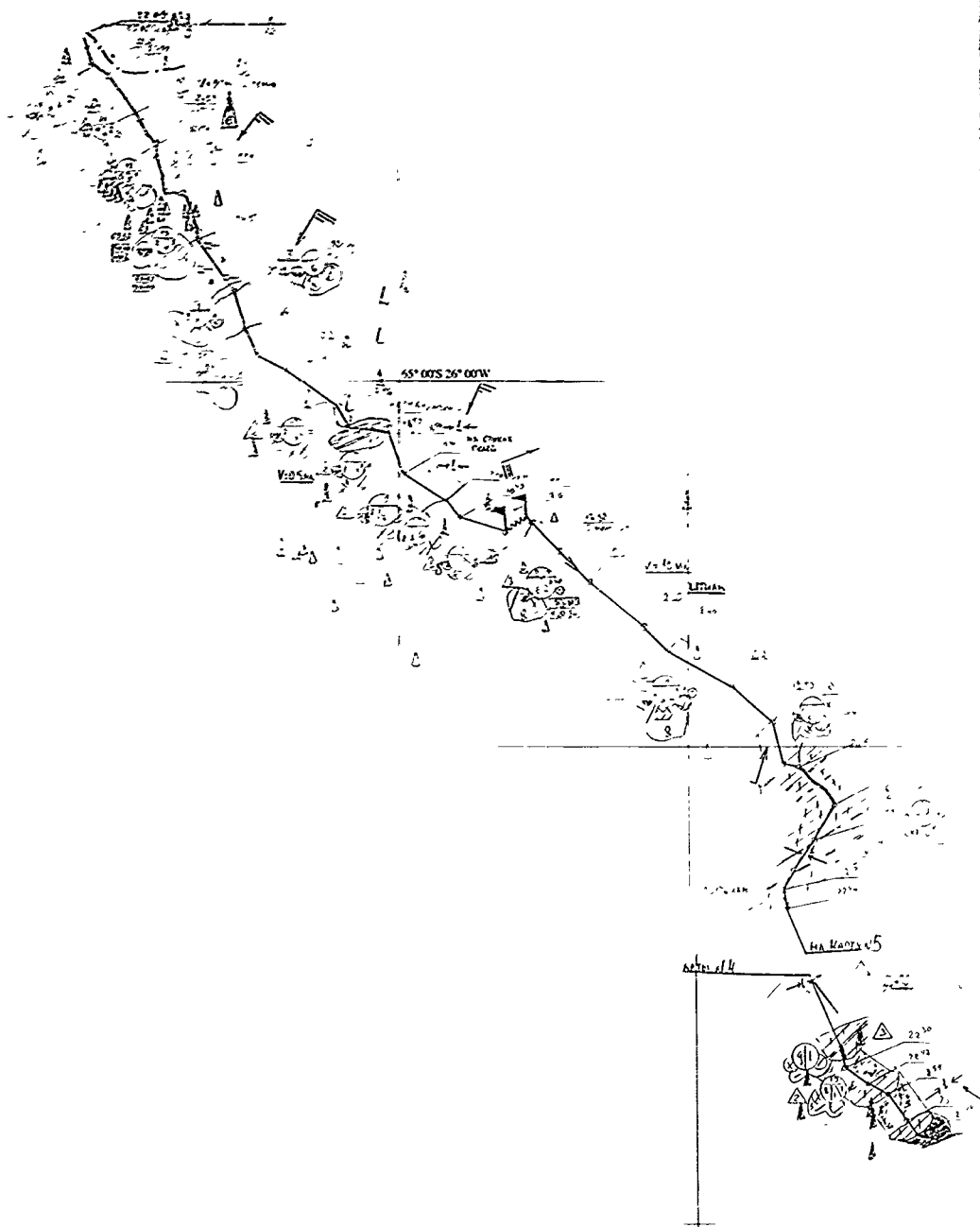


Figure 45 22 September ice map

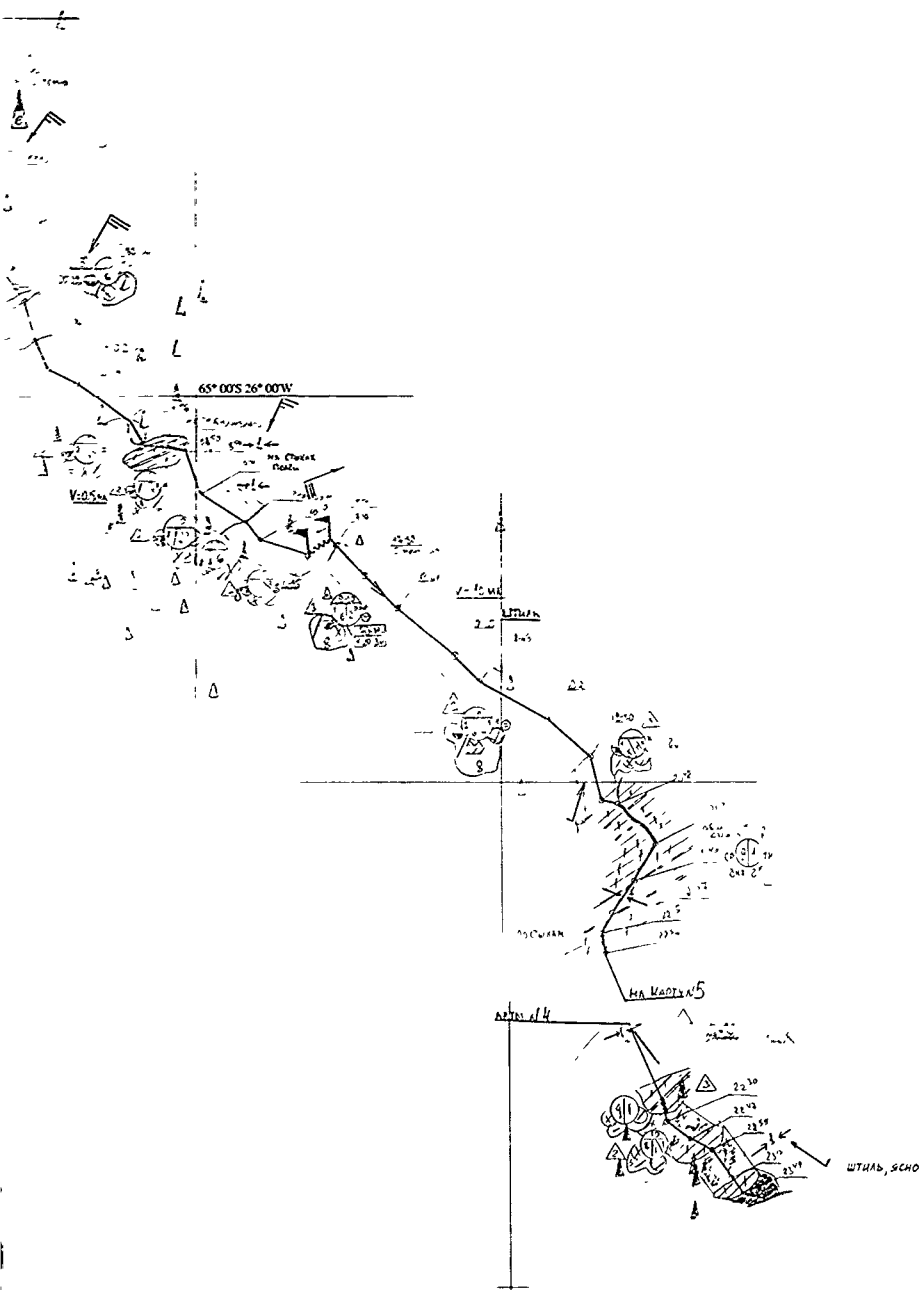
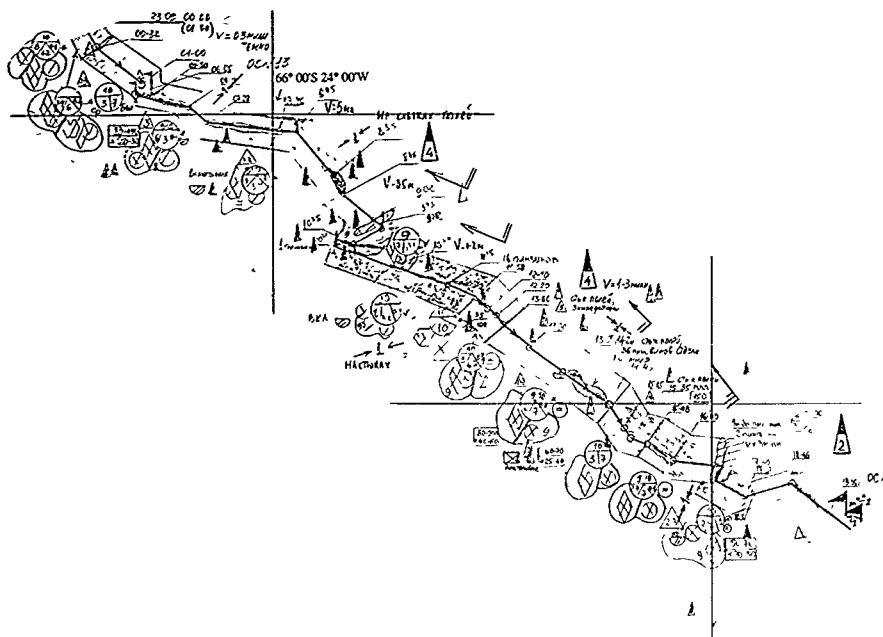


Figure 45 22 September ice map



Notes on observations
November 1964

Note scale change Each square is equal to 30' latitude 2° longitude

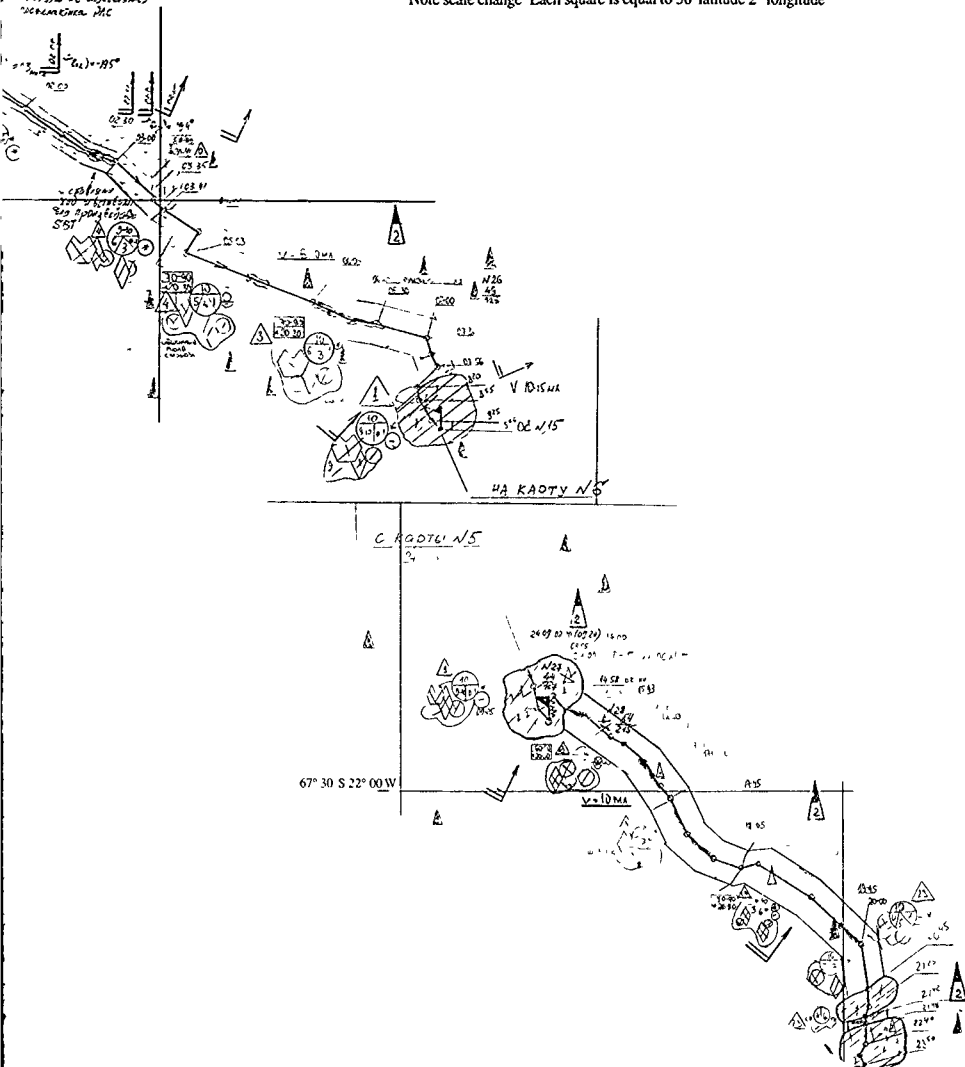


Figure 47 24 September ice map

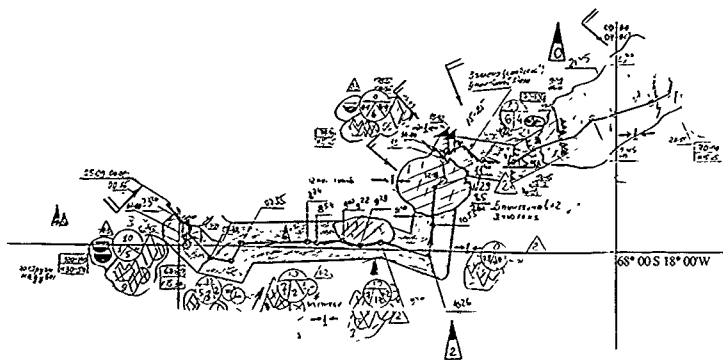


Figure 48 25 September ice map

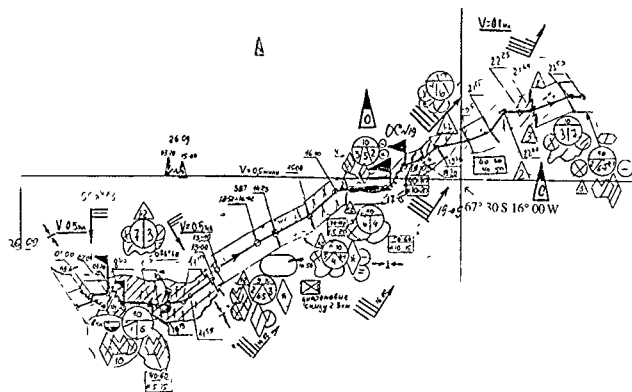


Figure 49 26 September ice map

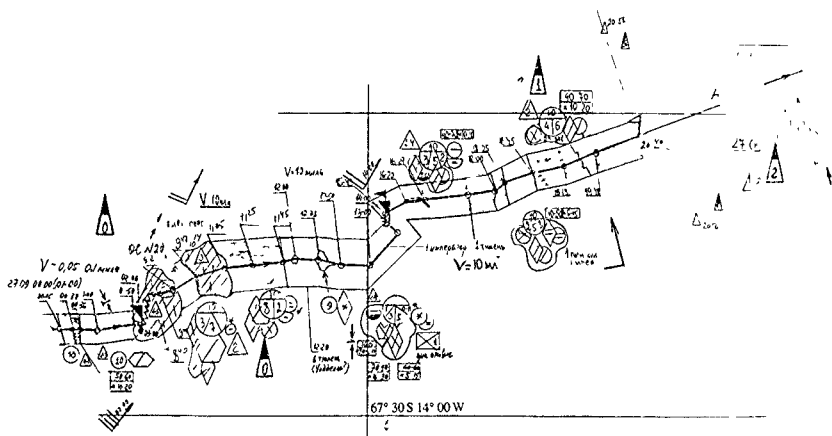


Figure 50 27 September ice map

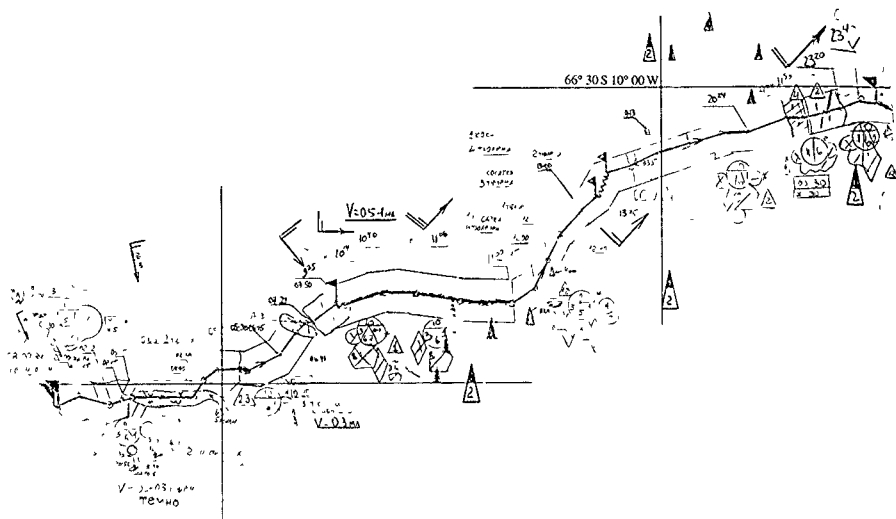


Figure 51 28 September ice map

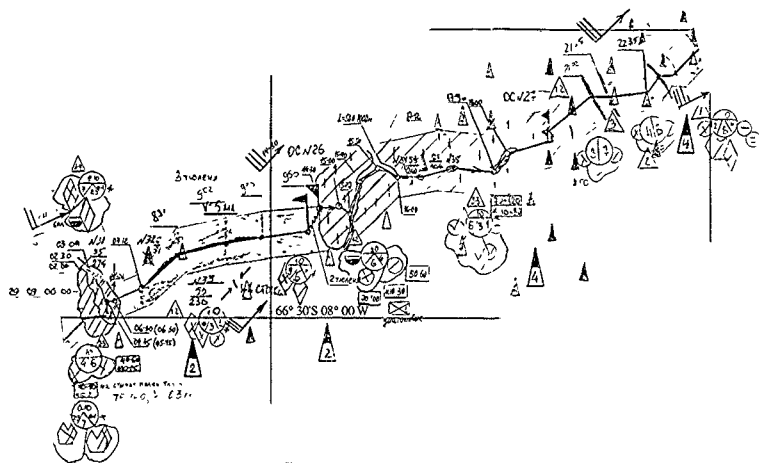


Figure 52 29 September ice map

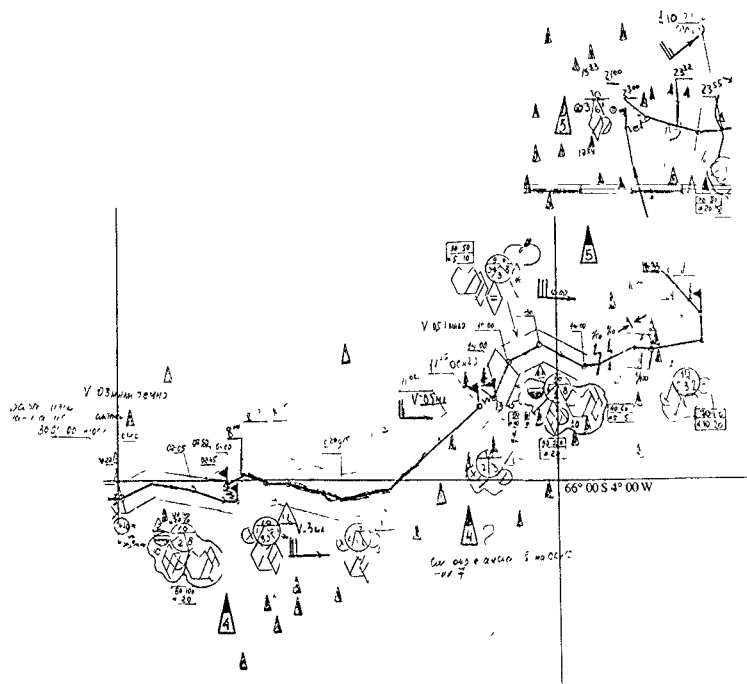


Figure 53 30 September ice map

A hand-drawn map of a coastal area, likely a harbor or bay, with various symbols, numbers, and annotations. The map is oriented with a compass rose in the top right corner, showing a bearing of 23° and a distance of 130'. The map features a central body of water with a large rectangular area labeled '20°' and '20°' (possibly indicating a bearing or distance). A prominent line runs diagonally across the map, with several points marked by numbers (e.g., 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100). The map also includes various symbols such as triangles, circles, and rectangles, some of which are labeled with numbers (e.g., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100). The map is drawn on a grid of squares, with a note in the top left corner stating 'Each square is equal to 30' latitude and 1° longitude'. The map is oriented with a compass rose in the top right corner, showing a bearing of 23° and a distance of 130'. The map features a central body of water with a large rectangular area labeled '20°' and '20°' (possibly indicating a bearing or distance). A prominent line runs diagonally across the map, with several points marked by numbers (e.g., 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100). The map also includes various symbols such as triangles, circles, and rectangles, some of which are labeled with numbers (e.g., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100). The map is drawn on a grid of squares, with a note in the top left corner stating 'Each square is equal to 30' latitude and 1° longitude'.

Figure 54 1 October ice map

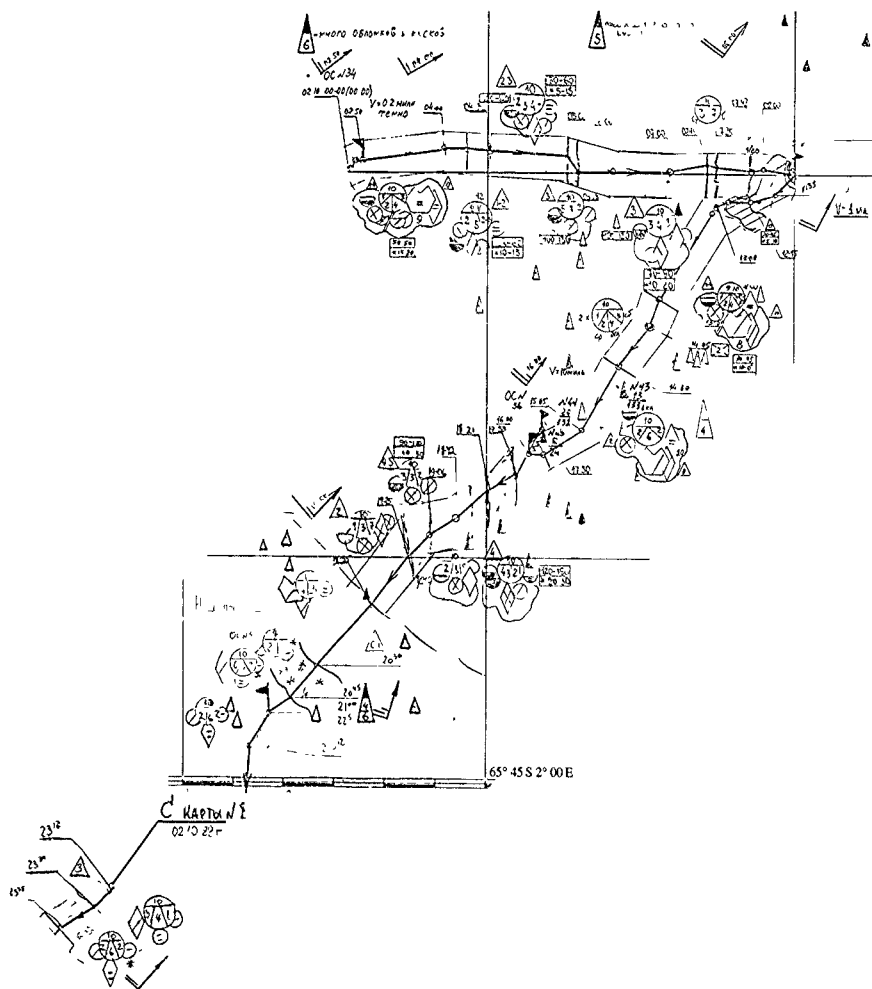


Figure 55 2 October ice map

Note scale change: Each square is equal to 30' latitude and 2° longitude.

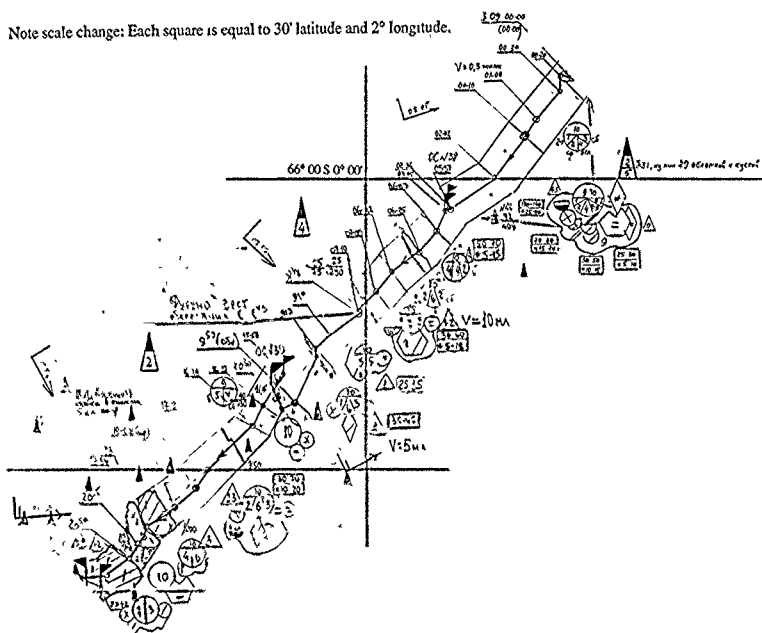
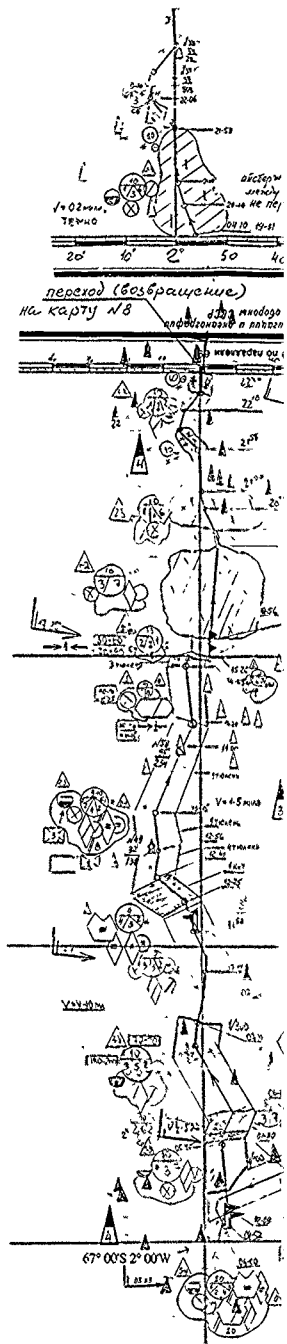


Figure S6. 3 October ice map.



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A hand-drawn map of the North Atlantic Ocean, oriented with North at the top. The map shows the eastern coast of North America on the left and the western coast of Europe on the right. A prominent shipping route is marked with a thick line, passing through the Gulf of Mexico, the Caribbean Sea, and the Atlantic Ocean. Various distances are noted along this route, such as "1000 miles" and "1000 miles". Other distances are marked between specific points, like "1000 miles" and "1000 miles". The map includes several islands, including the British Isles, Iceland, and the Azores. A compass rose is located in the upper left corner, showing the cardinal directions. The map is labeled with "N" for North and "S" for South. The title "NORTH ATLANTIC OCEAN" is written at the top. The map is drawn on a grid of latitude and longitude lines.

A hand-drawn sketch map of a coastal area, likely a harbor or bay. The map is oriented with a vertical line representing a central waterway or channel. On the left side, there are several small, irregular shapes representing buildings or structures, some with labels like 'A', 'B', and 'C'. A large, irregular shape in the upper left corner might represent a hill or a large building. On the right side, there are more buildings and structures, some with labels like 'A', 'B', and 'C'. A large, irregular shape in the upper right corner might represent a hill or a large building. The map includes various navigational markers, such as arrows indicating directions, and several small circles and dots. The overall style is that of a rough, hand-drawn sketch, possibly for a field report or a preliminary map.

1,000 400 bar on up

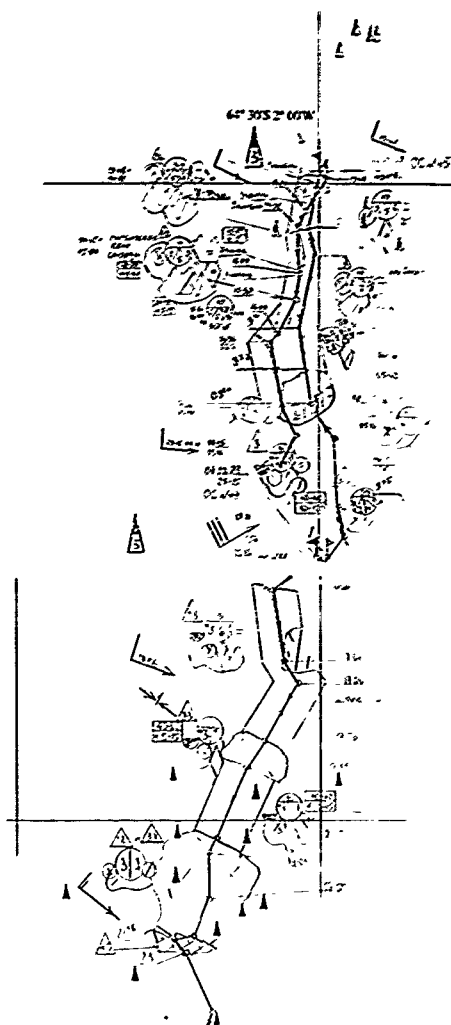


Figure 58 5 October use map

Note scale change: In the left section each square is equal to 2° longitude;
in the right section each square is equal to 1° longitude.

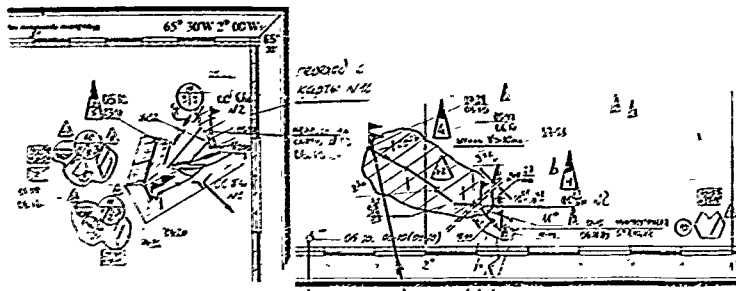


Figure 59 6 October ice map

Note scale change. Each square is equal to 30' latitude and 30' longitude

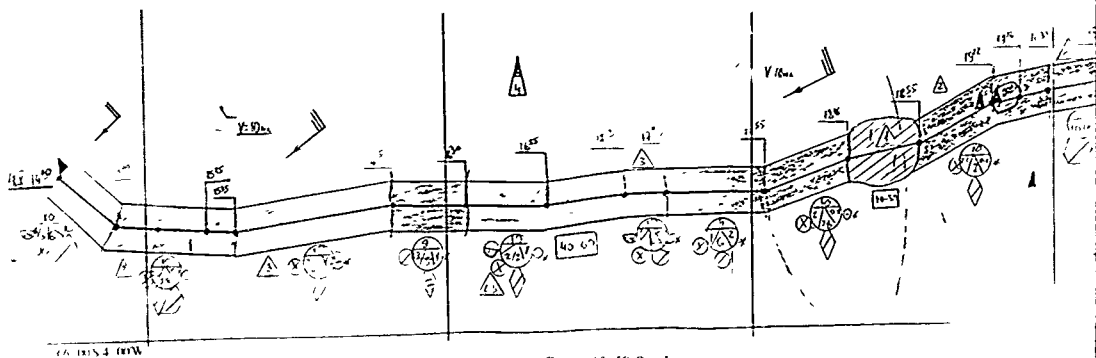


Figure 60 18 October ice map

Note scale change: In the left section each square is equal to 2° longitude;
in the right section each square is equal to 1° longitude.

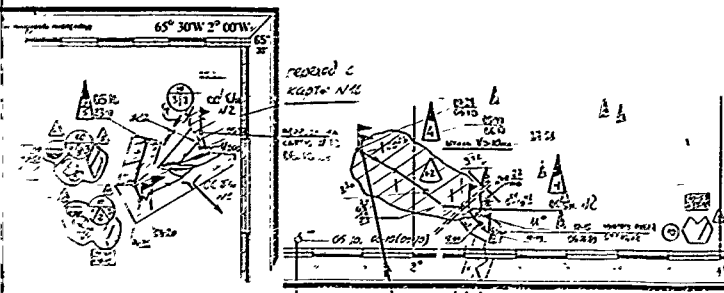


Figure 59 6 October ice map

Note scale change Each square is equal to 30' latitude and 30' longitude

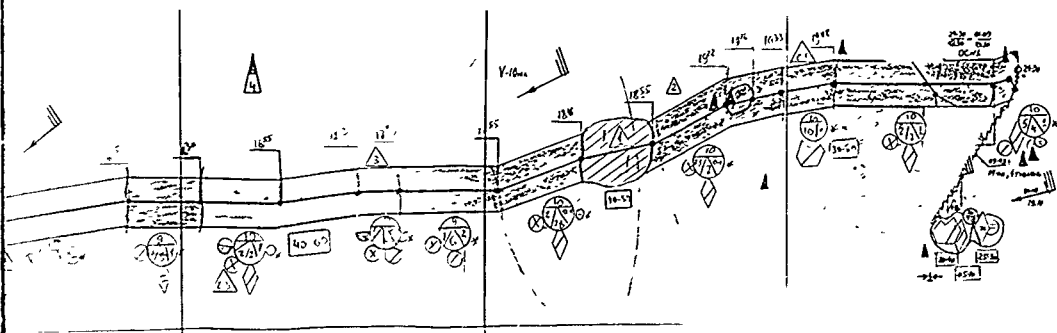
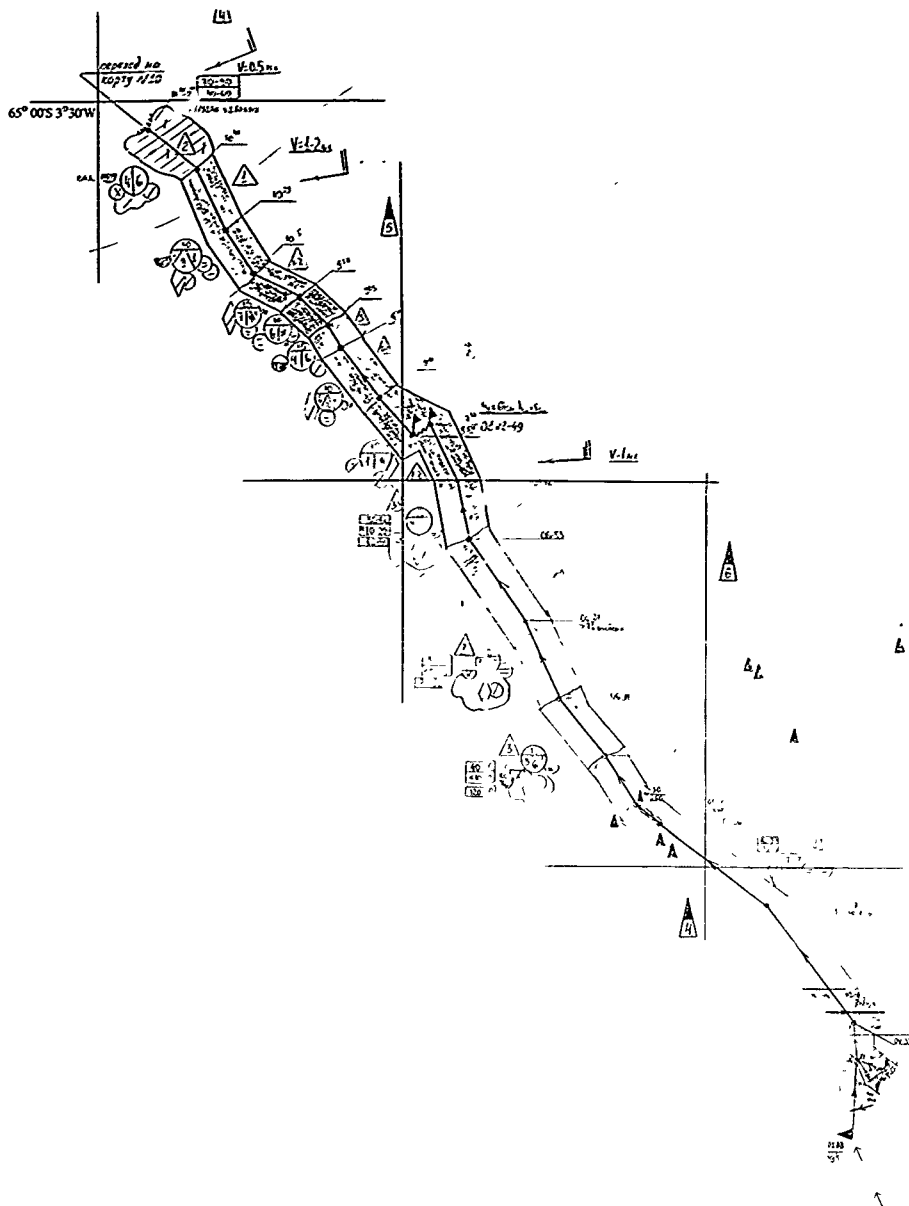
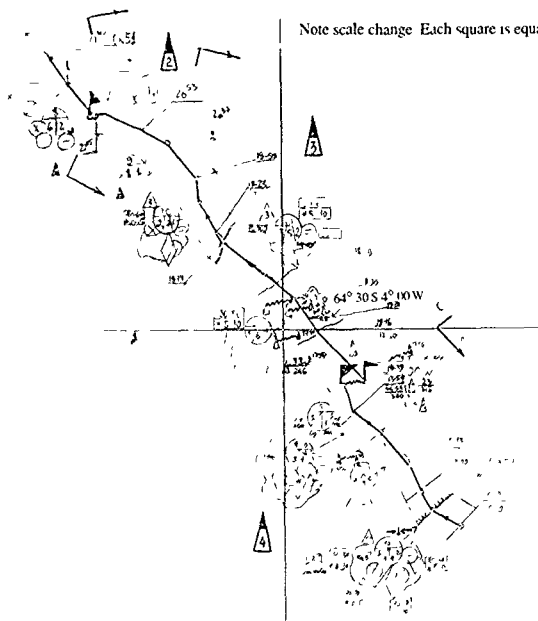


Figure 60 18 October ice map

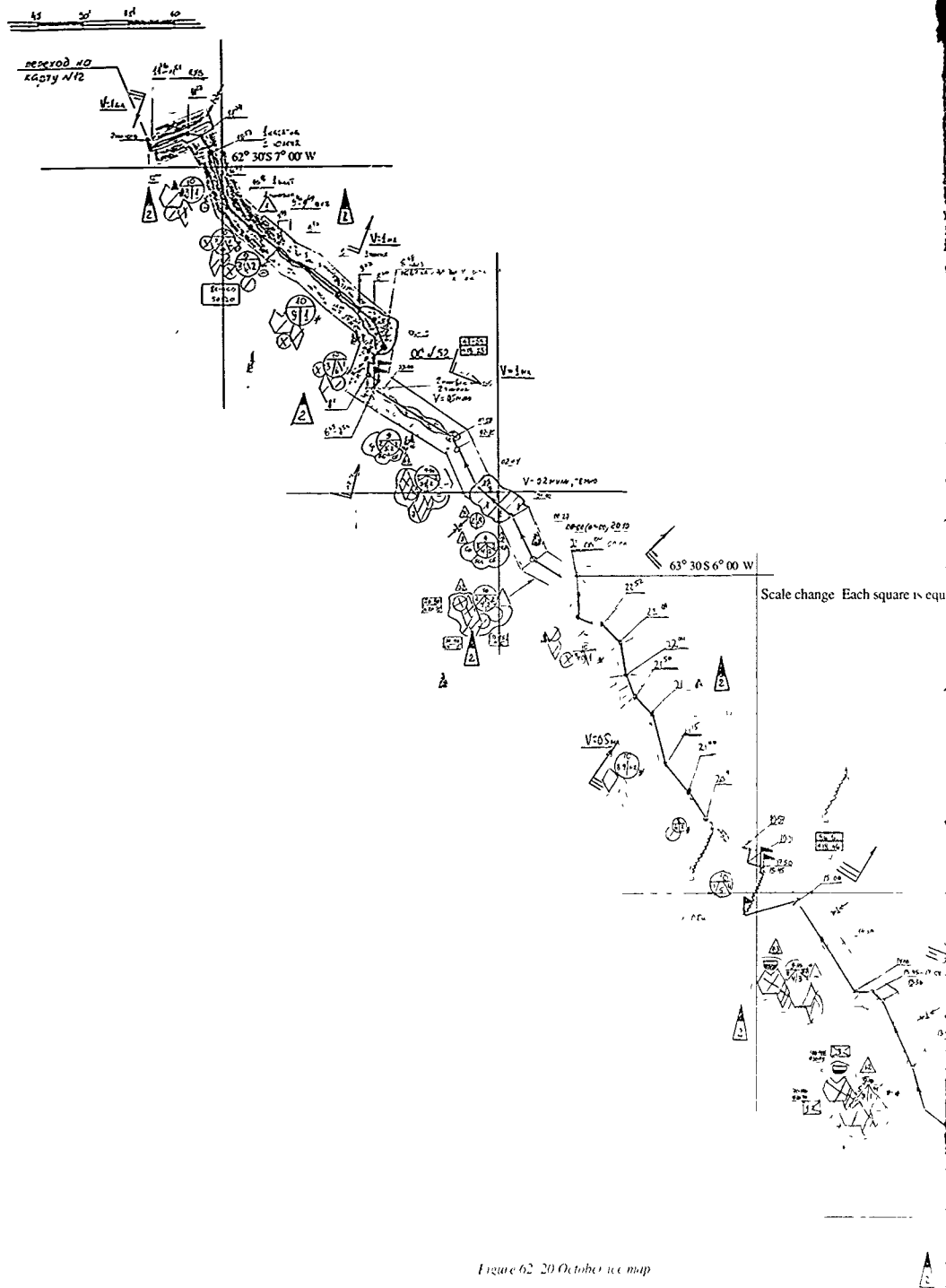


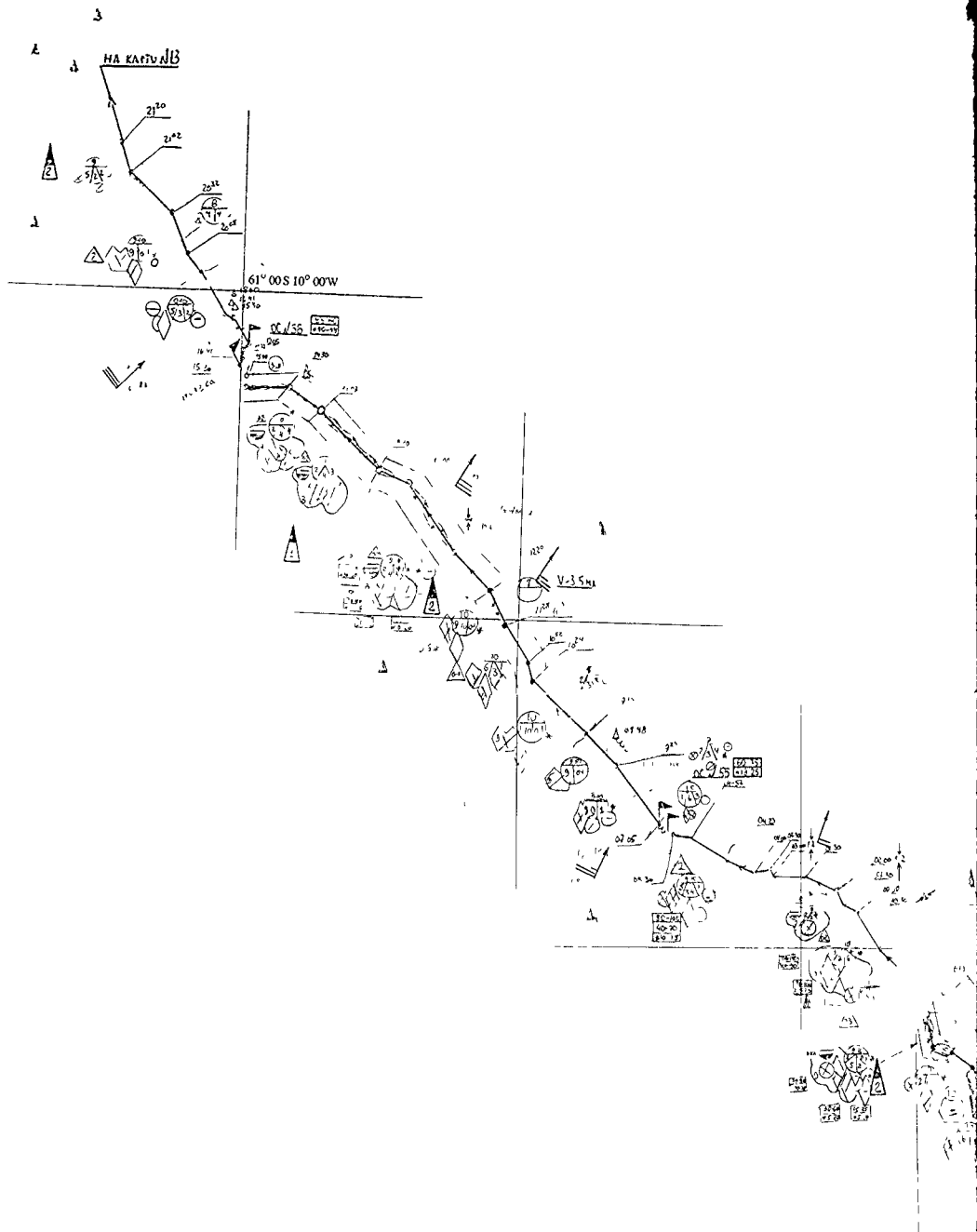


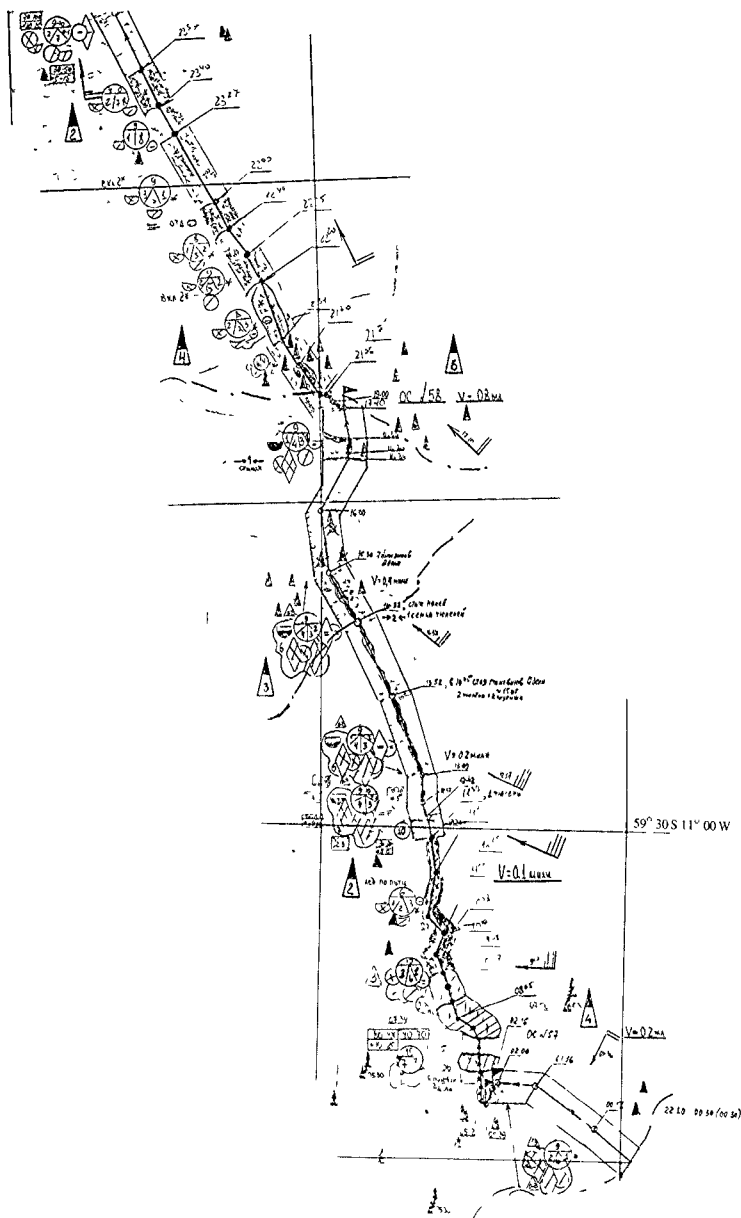
Note scale change Each square is equal to 30' latitude and 1° longitude

Note Ship track direction reverses as the *Fedorov* was now leaving the ice

Figure 61 19 October n e map







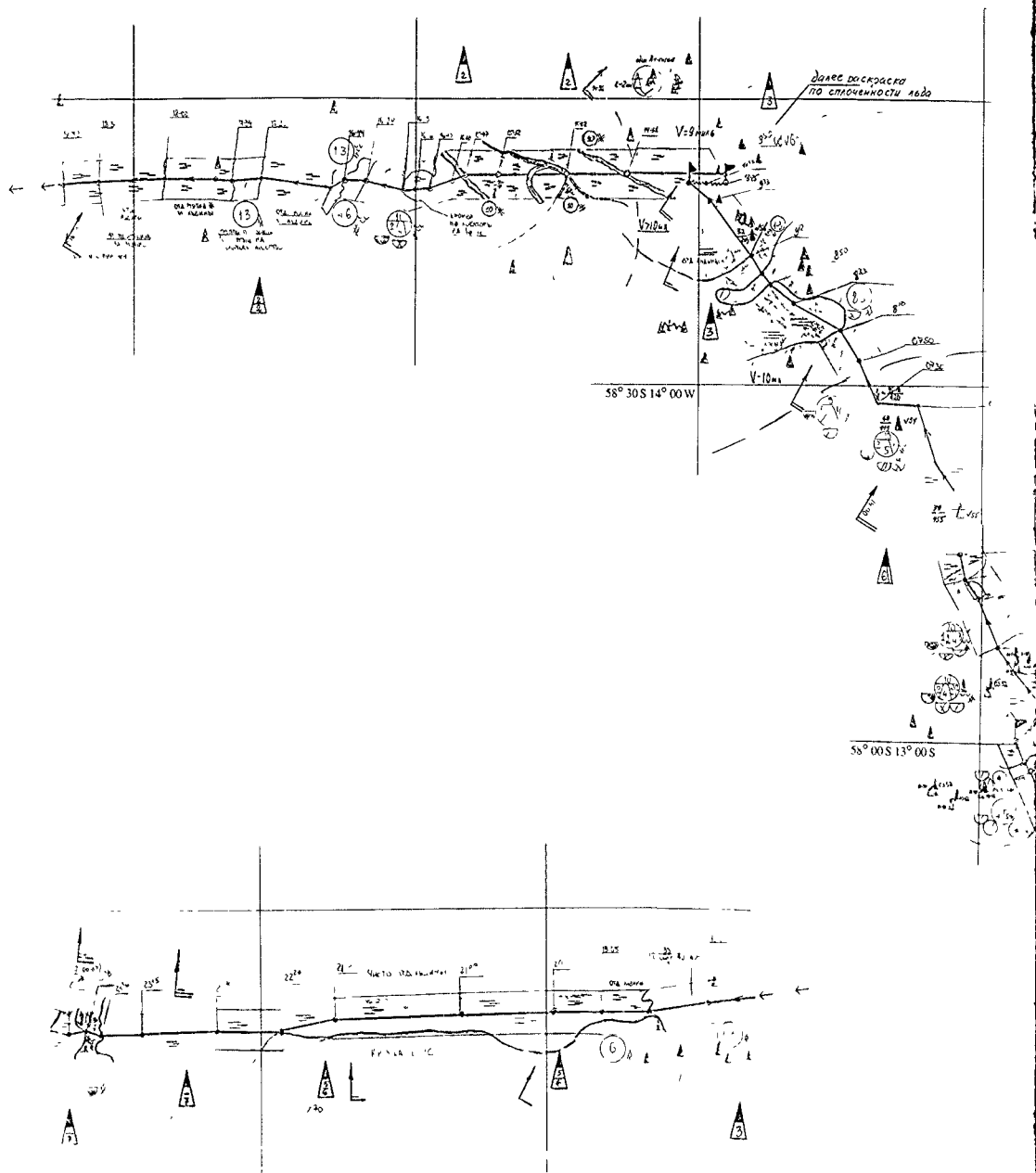


Figure 65 23 October ice map

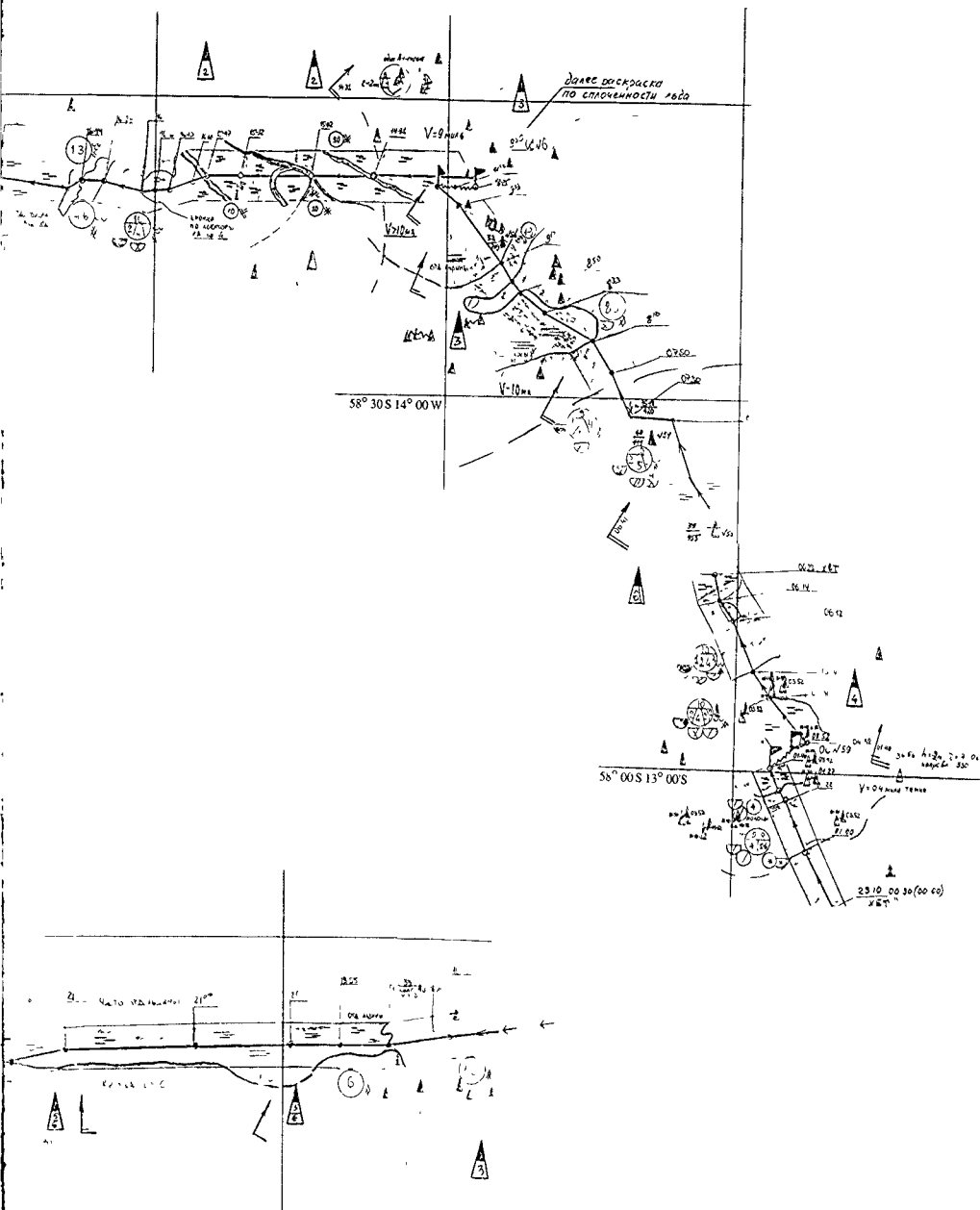
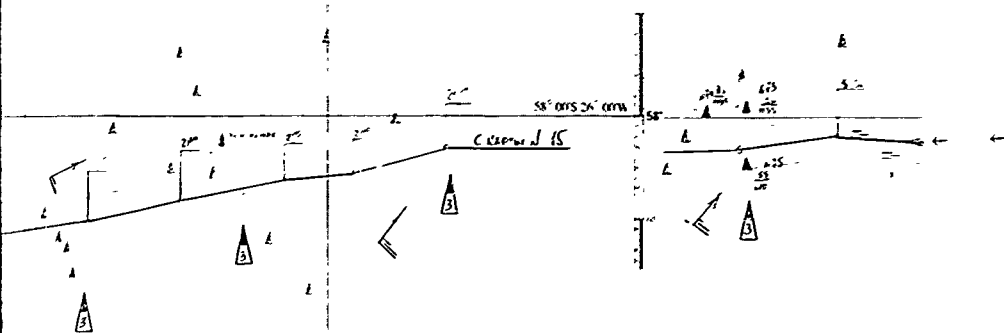
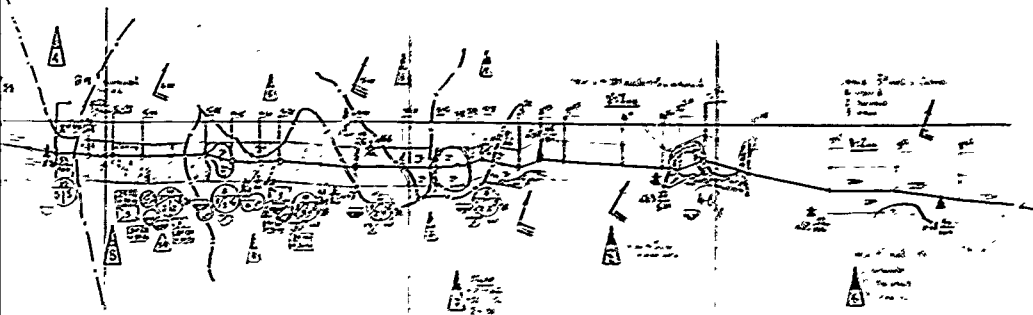


Figure 65 23 October ice map



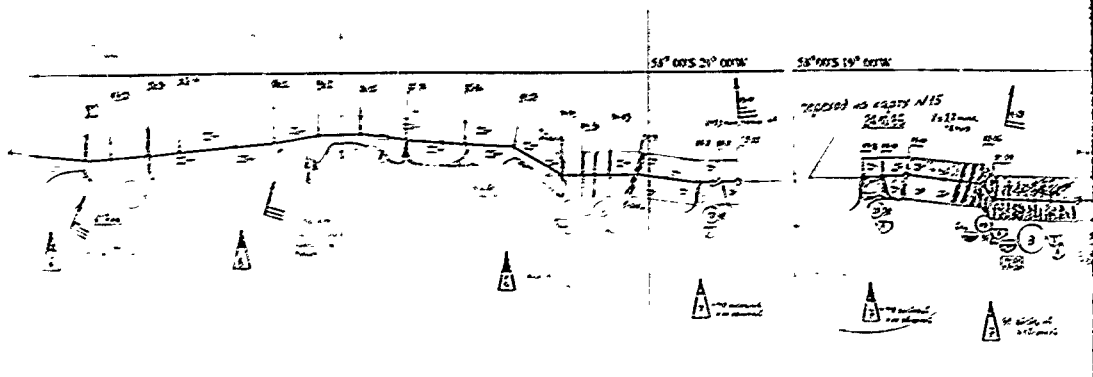


Figure 66 24 October ice map

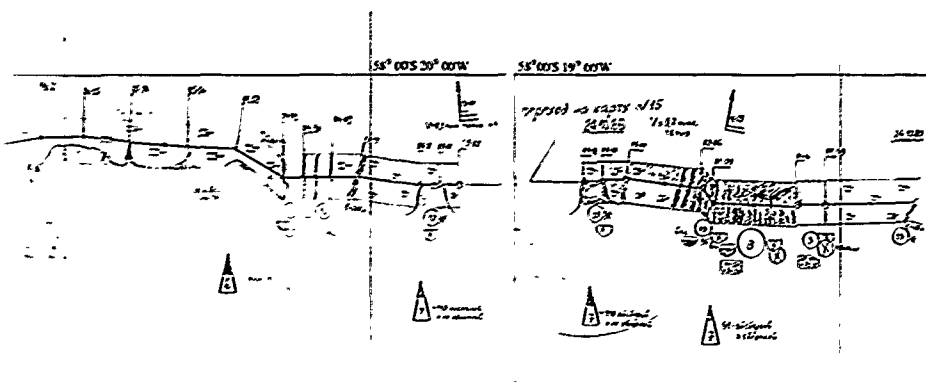
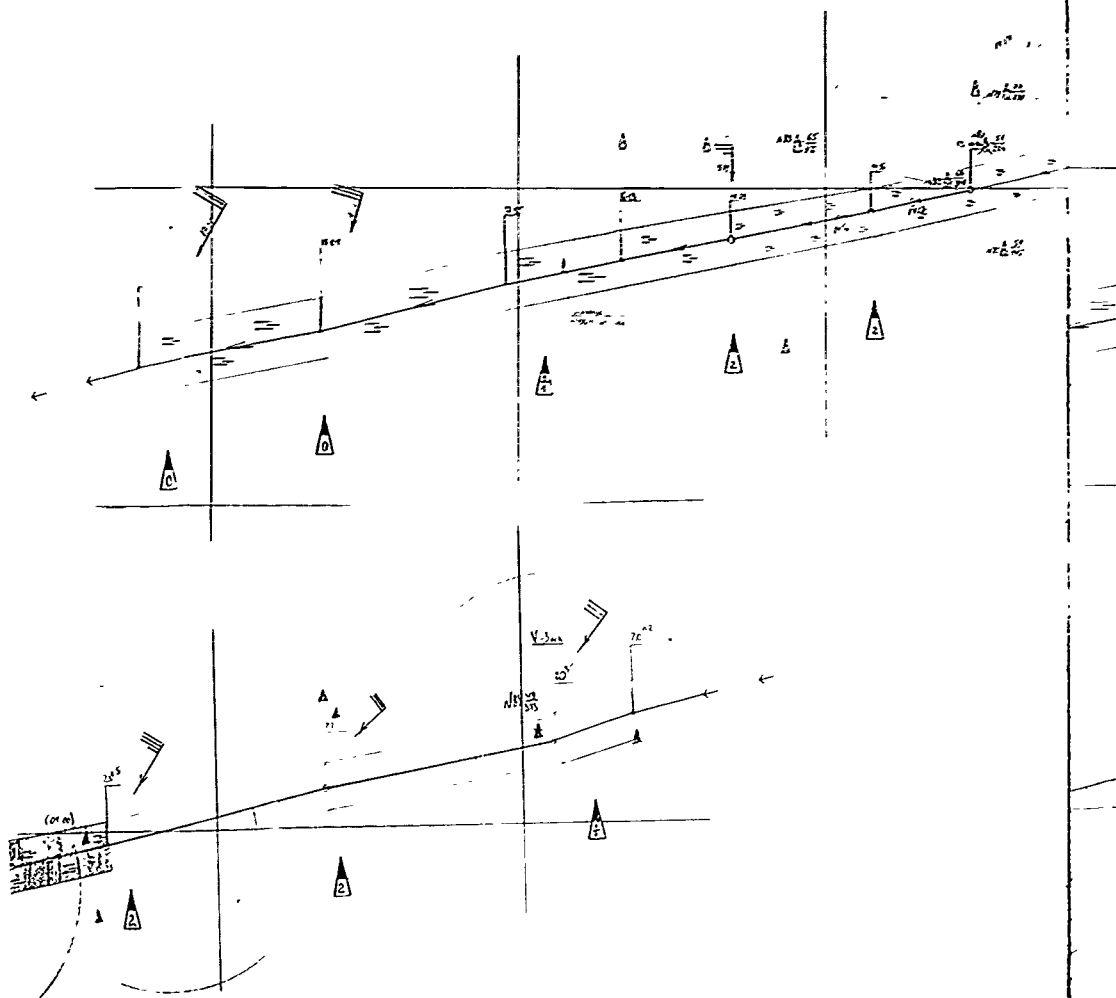


Figure 66 24 October ice map



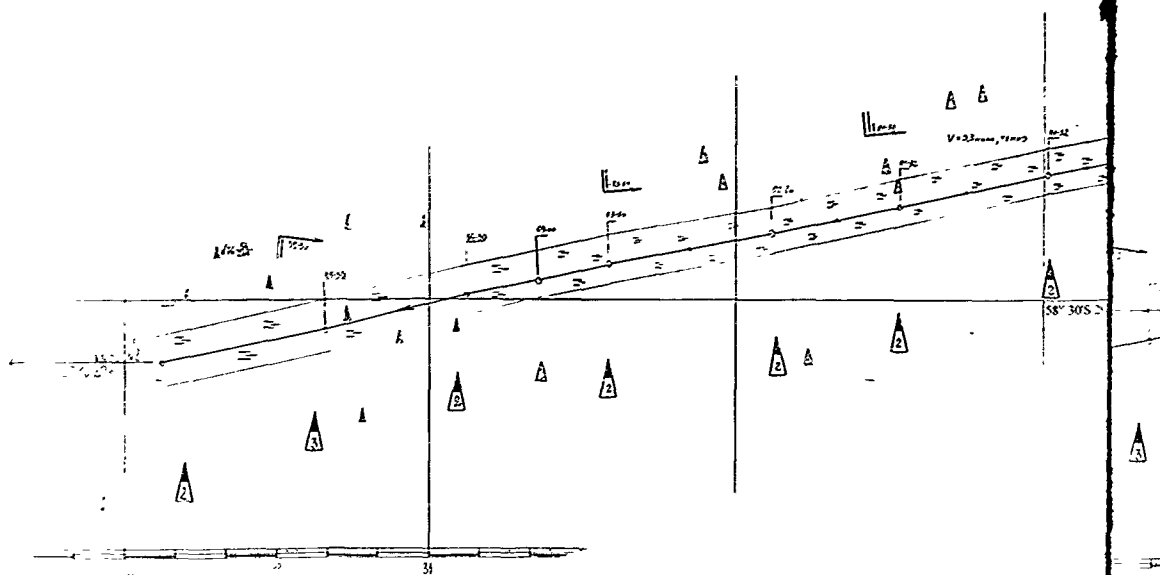


Figure 67 25 October ice map

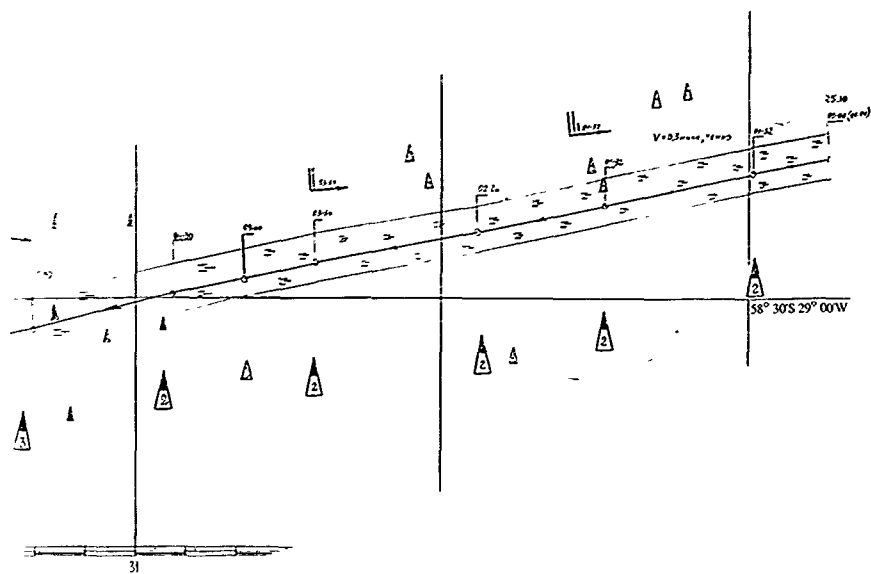
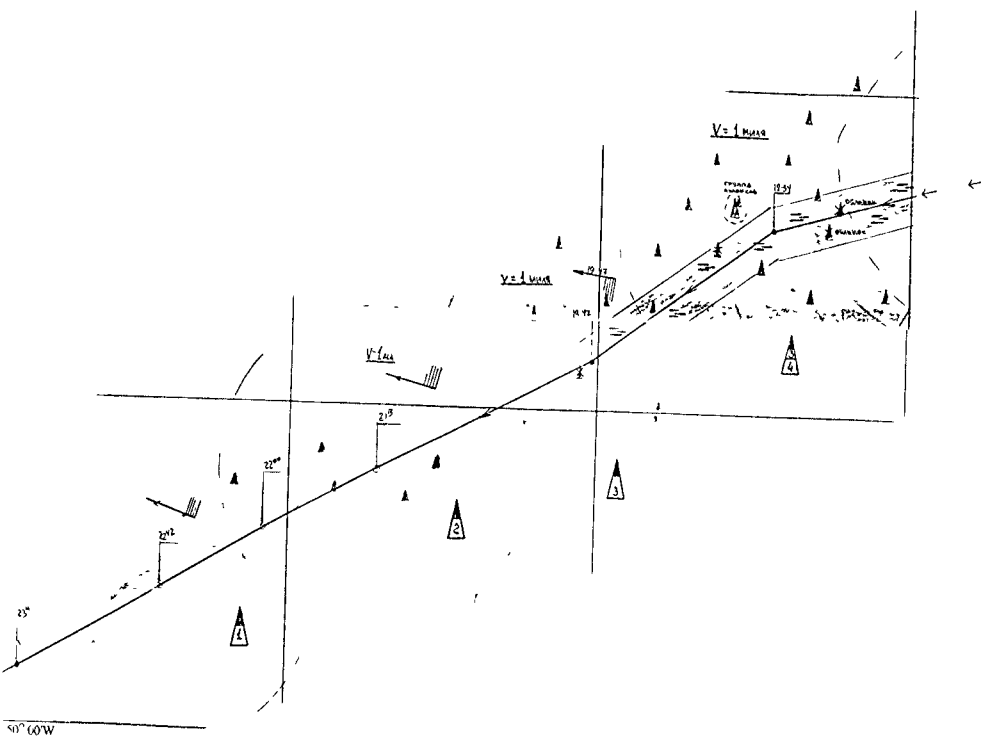
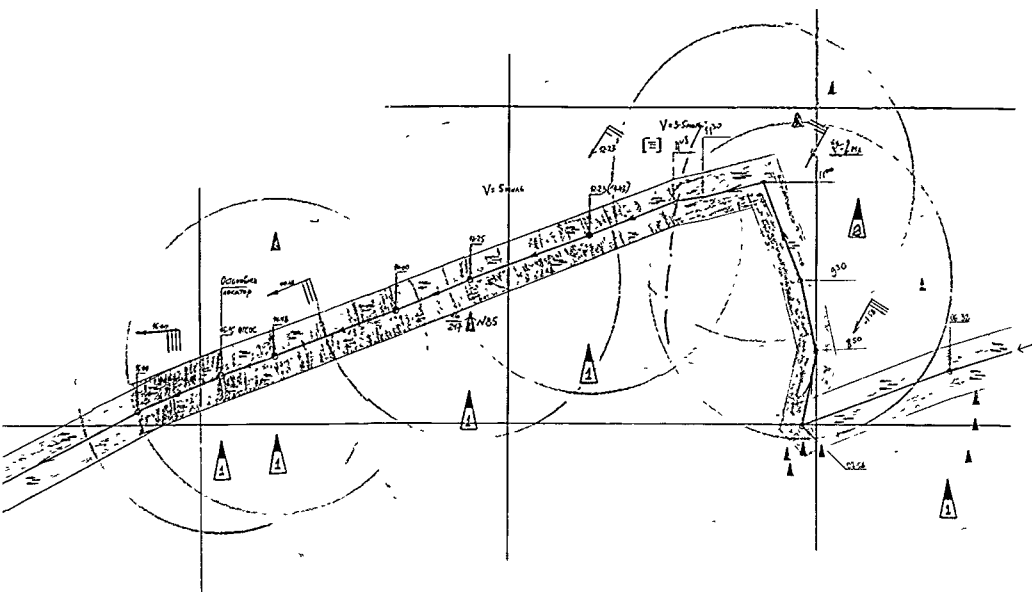


Figure 67 25 October ice map



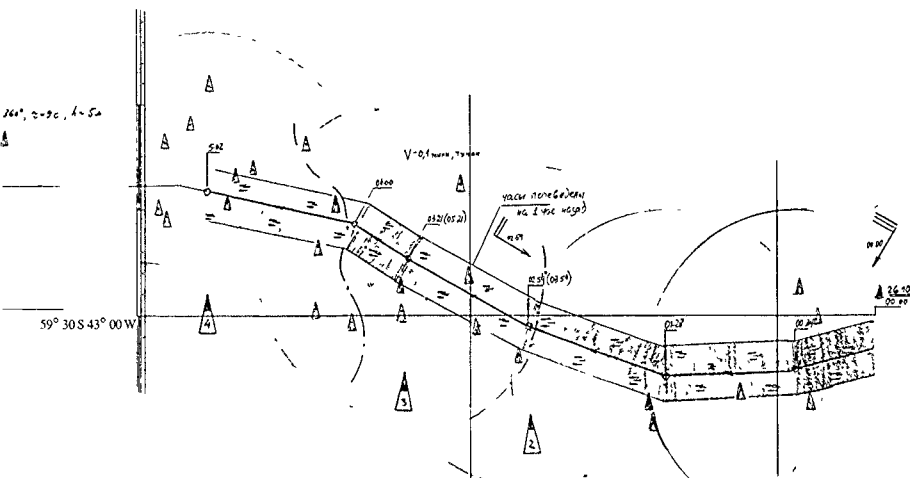
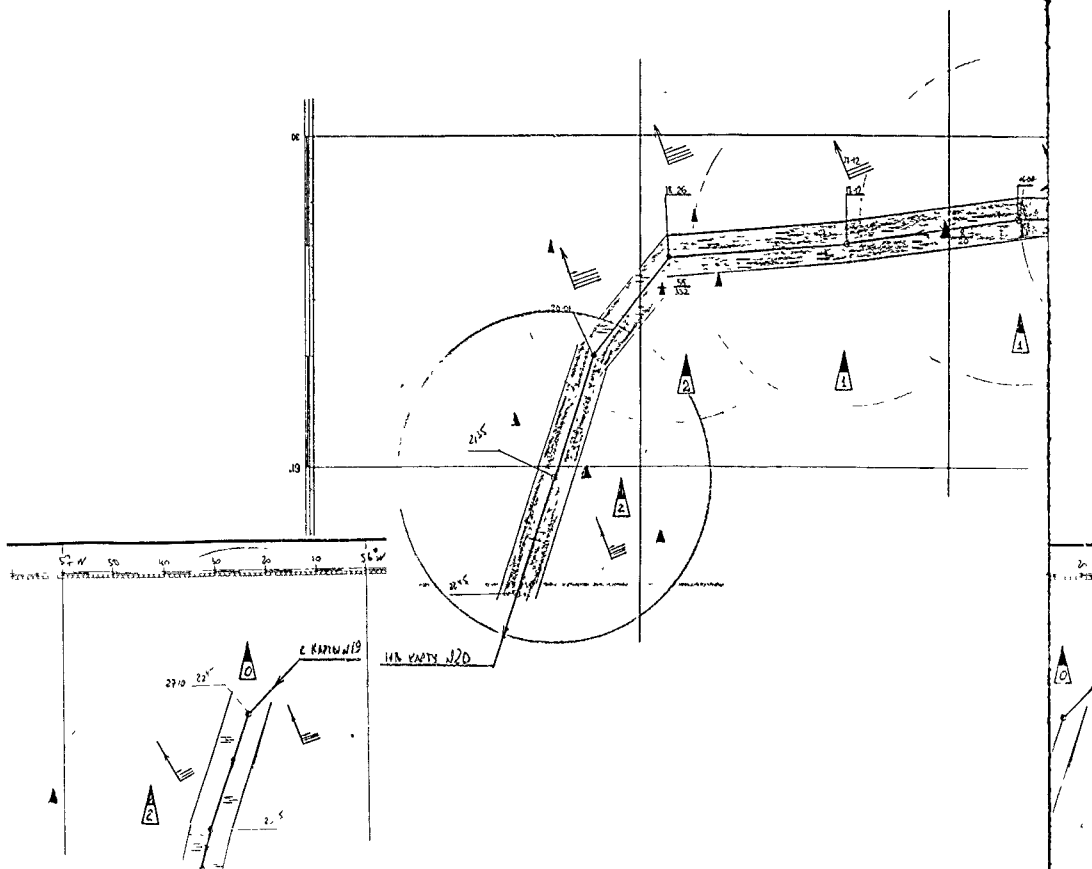
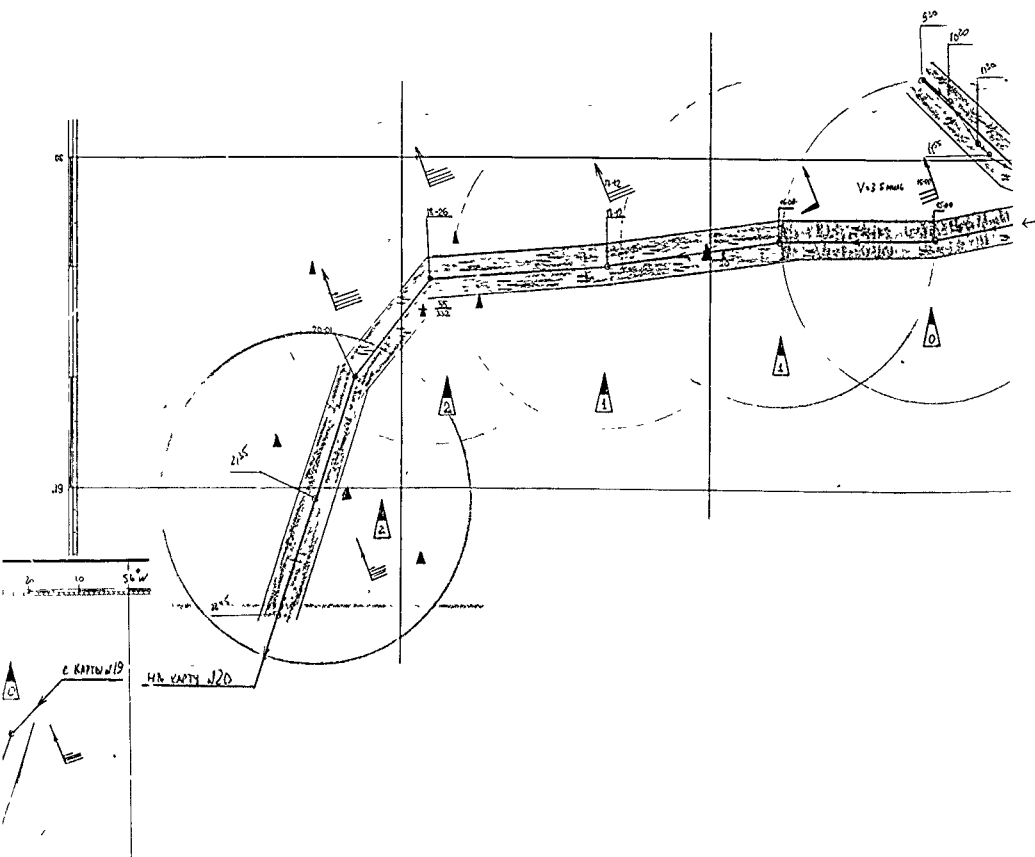


Figure 68 26 October ice map





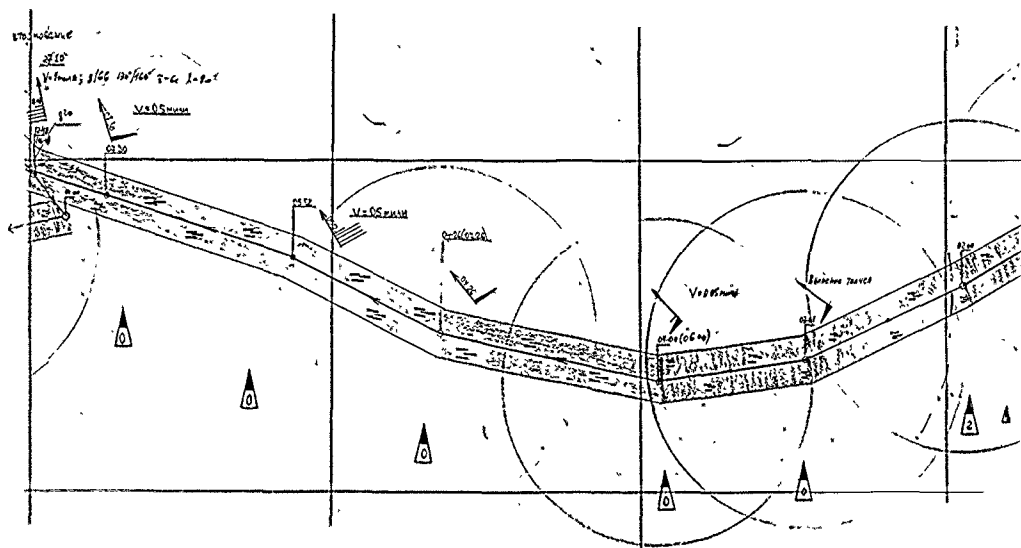


Figure 69. 27 October ice map.

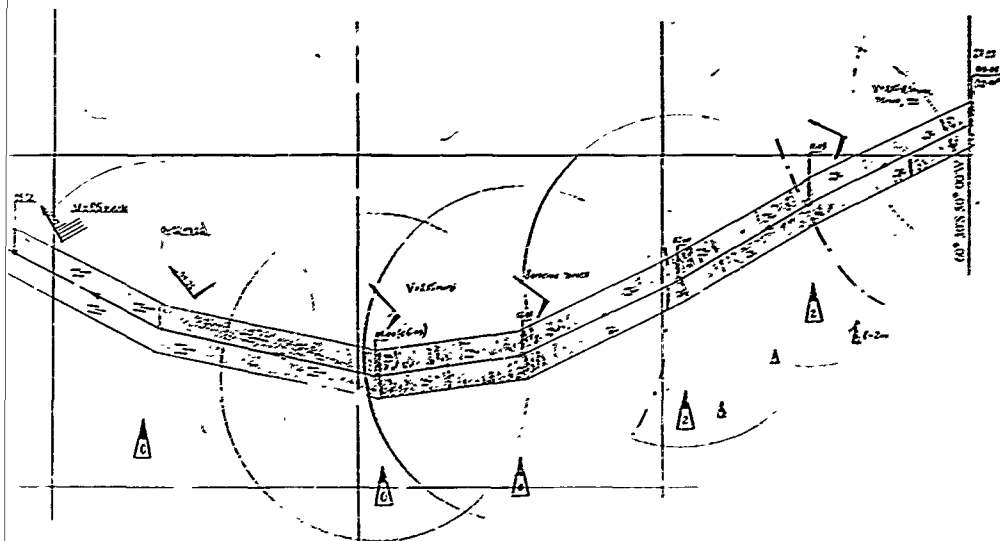


Figure 69 27 October ice map

FORM-SIZE THICK-THIN	SHAPES COLOR	CHARACTERISTICS DESCRIPTION
-------------------------	-----------------	--------------------------------

SPREADSHEET ICE PACK ICE

③	③	CONCENTRATED ICE (CONCENTRATION 15-20%) COMPACTED PACK ICE
③	③	POOR CONCENTRATED ICE (CONCENTRATION 5-15%) VERY CLOSE PACK ICE
⑦	⑦	CONCENTRATED ICE (CONCENTRATION 15-25%) CLOSE PACK ICE
③	③	FEW CONCENTRATED ICE (CONCENTRATION 15-25%) OPEN PACK ICE
③	③	FEW ICE (CONCENTRATION 15-25%) VERY OPEN PACK ICE
③	③	FEW ICE (CONCENTRATION 15-25%) ICE FREE

1	2	3
4	5	6
7	8	9
10	11	12
13	14	15
16	17	18
19	20	21
22	23	24
25	26	27
28	29	30
31	32	33
34	35	36
37	38	39
40	41	42
43	44	45
46	47	48
49	50	51
52	53	54
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748	749	750
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763	764	765
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787	788	789
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796	797	798
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823	824	825
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829	830	831
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976	977	978
979	980	981
982	983	984
985	986	987
988	989	990
991	992	993
994	995	996
997	998	999
1000	1001	1002

FORM-SIZE THICK-THIN	SHAPES COLOR	CHARACTERISTICS DESCRIPTION
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③	③	CONCENTRATED ICE (CONCENTRATION 15-20%) COMPACTED PACK ICE
③	③	POOR CONCENTRATED ICE (CONCENTRATION 5-15%) VERY CLOSE PACK ICE
⑦	⑦	CONCENTRATED ICE (CONCENTRATION 15-25%) CLOSE PACK ICE
③	③	FEW CONCENTRATED ICE (CONCENTRATION 15-25%) OPEN PACK ICE
③	③	FEW ICE (CONCENTRATION 15-25%) VERY OPEN PACK ICE
③	③	FEW ICE (CONCENTRATION 15-25%) ICE FREE

SPREADSHEET ICE PACK ICE

FORM-SIZE THICK-THIN	SHAPES COLOR	CHARACTERISTICS DESCRIPTION
③	③	CONCENTRATED ICE (CONCENTRATION 15-20%) COMPACTED PACK ICE
③	③	POOR CONCENTRATED ICE (CONCENTRATION 5-15%) VERY CLOSE PACK ICE
⑦	⑦	CONCENTRATED ICE (CONCENTRATION 15-25%) CLOSE PACK ICE
③	③	FEW CONCENTRATED ICE (CONCENTRATION 15-25%) OPEN PACK ICE
③	③	FEW ICE (CONCENTRATION 15-25%) VERY OPEN PACK ICE
③	③	FEW ICE (CONCENTRATION 15-25%) ICE FREE

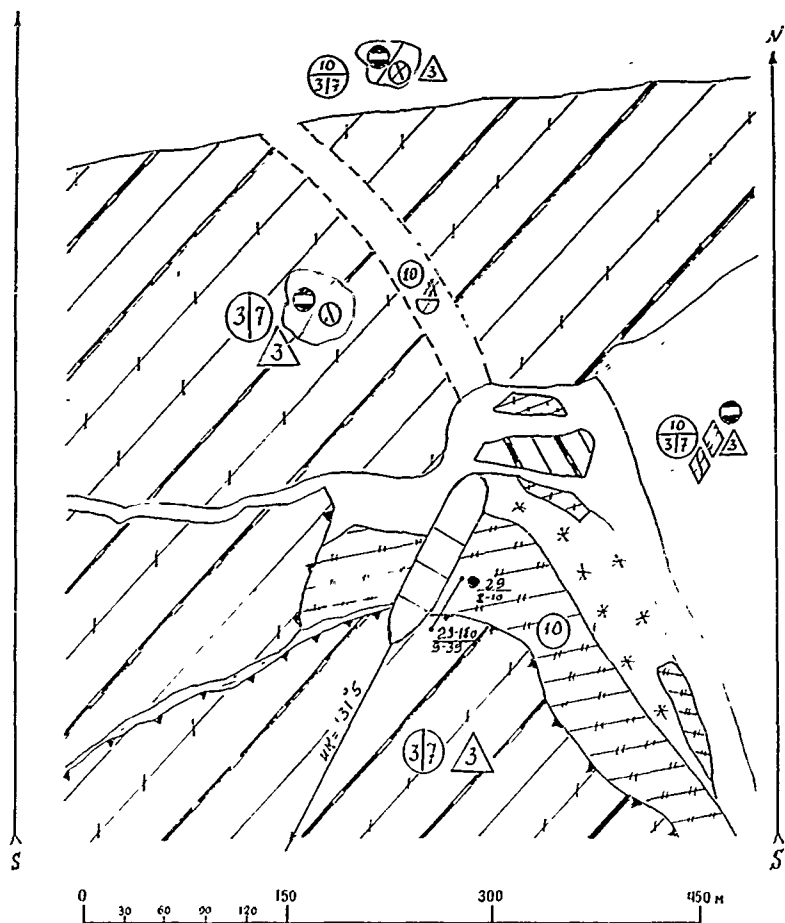
FORM-SIZE THICK-THIN	SHAPES COLOR	CHARACTERISTICS DESCRIPTION
-------------------------	-----------------	--------------------------------

③	③	CONCENTRATED ICE (CONCENTRATION 15-20%) COMPACTED PACK ICE
③	③	POOR CONCENTRATED ICE (CONCENTRATION 5-15%) VERY CLOSE PACK ICE
⑦	⑦	CONCENTRATED ICE (CONCENTRATION 15-25%) CLOSE PACK ICE
③	③	FEW CONCENTRATED ICE (CONCENTRATION 15-25%) OPEN PACK ICE
③	③	FEW ICE (CONCENTRATION 15-25%) VERY OPEN PACK ICE
③	③	FEW ICE (CONCENTRATION 15-25%) ICE FREE

FORM-SIZE THICK-THIN	SHAPES COLOR	CHARACTERISTICS DESCRIPTION
-------------------------	-----------------	--------------------------------

③	③	CONCENTRATED ICE (CONCENTRATION 15-20%) COMPACTED PACK ICE
③	③	POOR CONCENTRATED ICE (CONCENTRATION 5-15%) VERY CLOSE PACK ICE
⑦	⑦	CONCENTRATED ICE (CONCENTRATION 15-25%) CLOSE PACK ICE
③	③	FEW CONCENTRATED ICE (CONCENTRATION 15-25%) OPEN PACK ICE
③	③	FEW ICE (CONCENTRATION 15-25%) VERY OPEN PACK ICE
③	③	FEW ICE (CONCENTRATION 15-25%) ICE FREE

Legend on page 99.



ЛЕДОВАЯ ОБСТАНОВКА

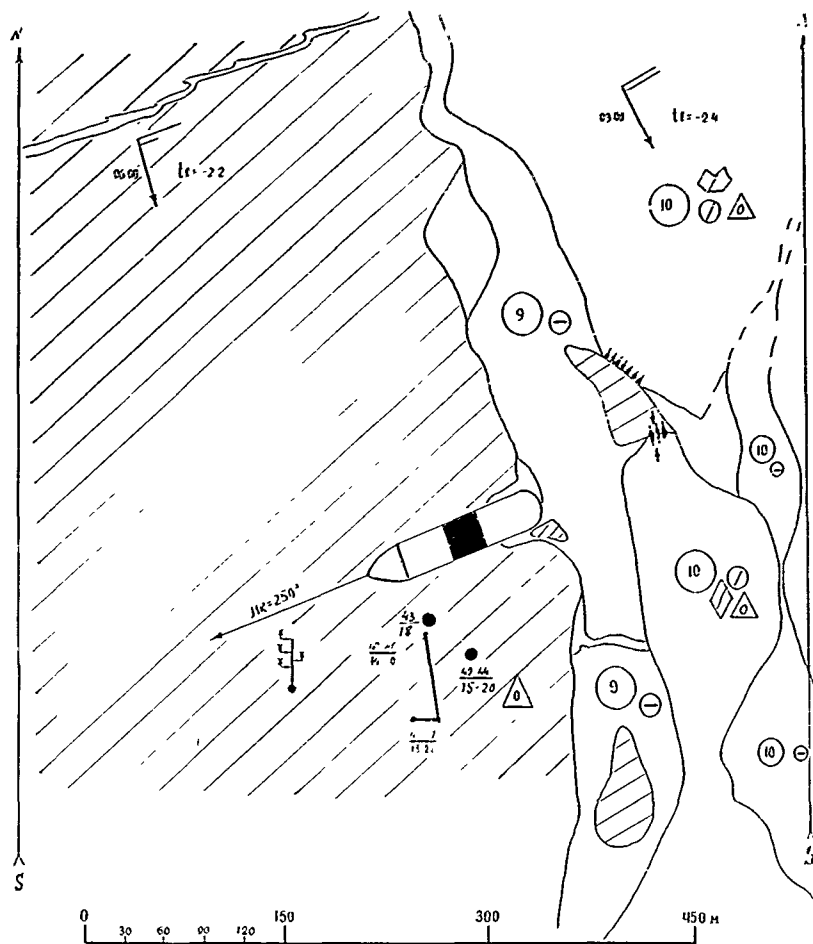
Океанографическая станция 14-45 дата 19 сентября 1989

координаты начала

координаты конца

 $\varphi = 61^{\circ} 20' 0''$ $\varphi = 61^{\circ} 19' 5''$ $\lambda = 32^{\circ} 51' 0''$ $\lambda = 32^{\circ} 49' 8''$ время начала = $15^h 30^m$
СМТ $14^h 30^m$ время конца = $18^h 30^m$
СМТ $20^h 30^m$

Figure 7* 19 September, ice station 15



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 16 дата: 20 сентября 1989

координаты начала координаты конца

$\varphi = 62^{\circ}05' S$

$\varphi = 62^{\circ}05' S$

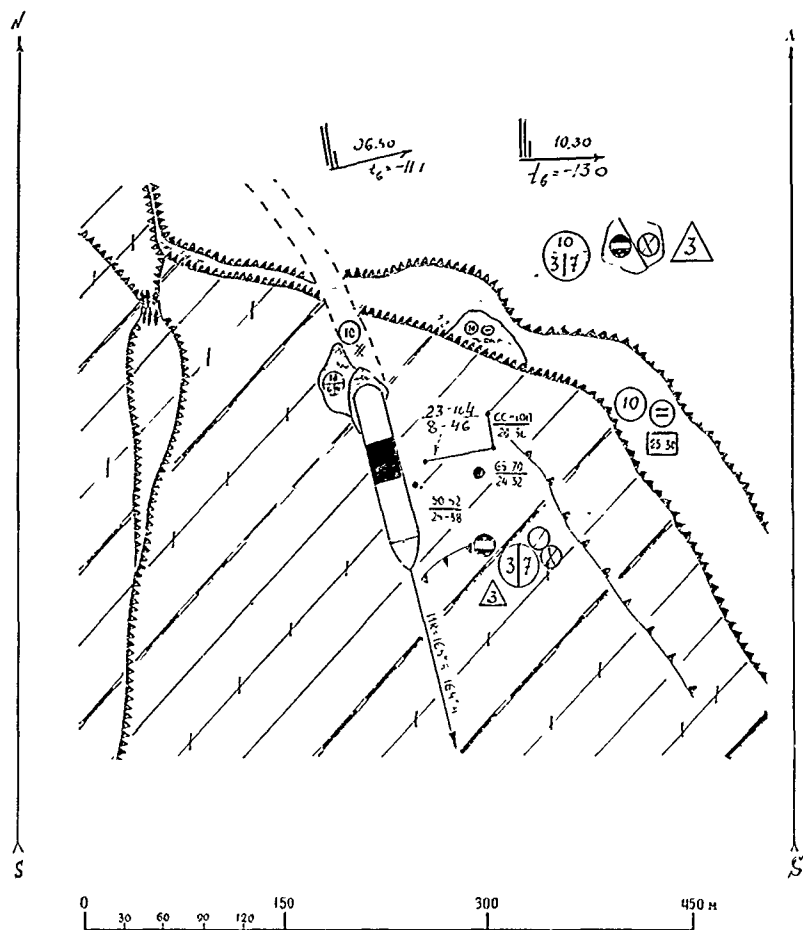
$\lambda = 31^{\circ}29' W$

$\lambda = 31^{\circ}26' W$

НЧ-МЧ НЧ-ЛЧ = 05^h50^m
ВМТ 06^h50^m

НЧ-МЧ НЧ-ЛЧ = 03^h59^m
ВМТ 10^h59^m

Figure 72 20 September ice station 16



ПЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 18 дата. 21 сентября 1989

координаты начала координаты конца

$\varphi = 65^{\circ} 57' 55''$

$\varphi = 65^{\circ} 57' 55''$

$\lambda = 28^{\circ} 42' 7''$

$\lambda = 28^{\circ} 50' 1''$

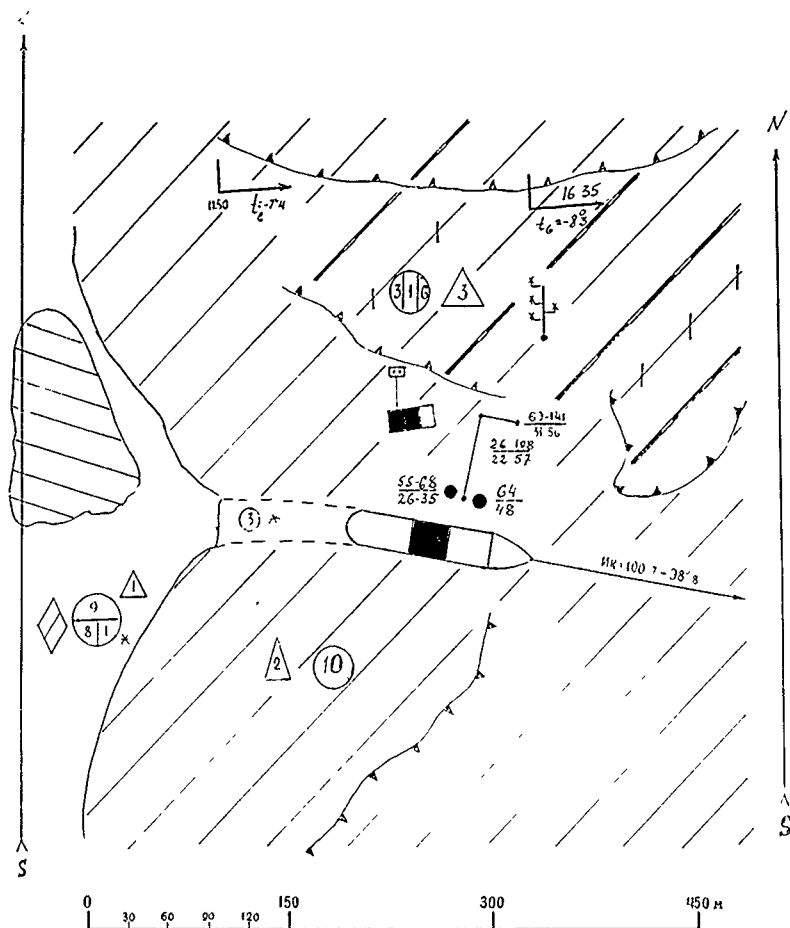
время начала = 05^h 45^m

время конца = 10^h 30^m

СМТ 06^h 45^m

СМТ 11^h 30^m

Figure 74 21 September ice station 18



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 20 дата: 22 сентября 1989

координаты начала

координаты конца

$\varphi = 65^{\circ} 12' 25''$

$\varphi = 65^{\circ} 11' 5''$

$\lambda = 25^{\circ} 57' 40''$

$\lambda = 25^{\circ} 43' 7''$

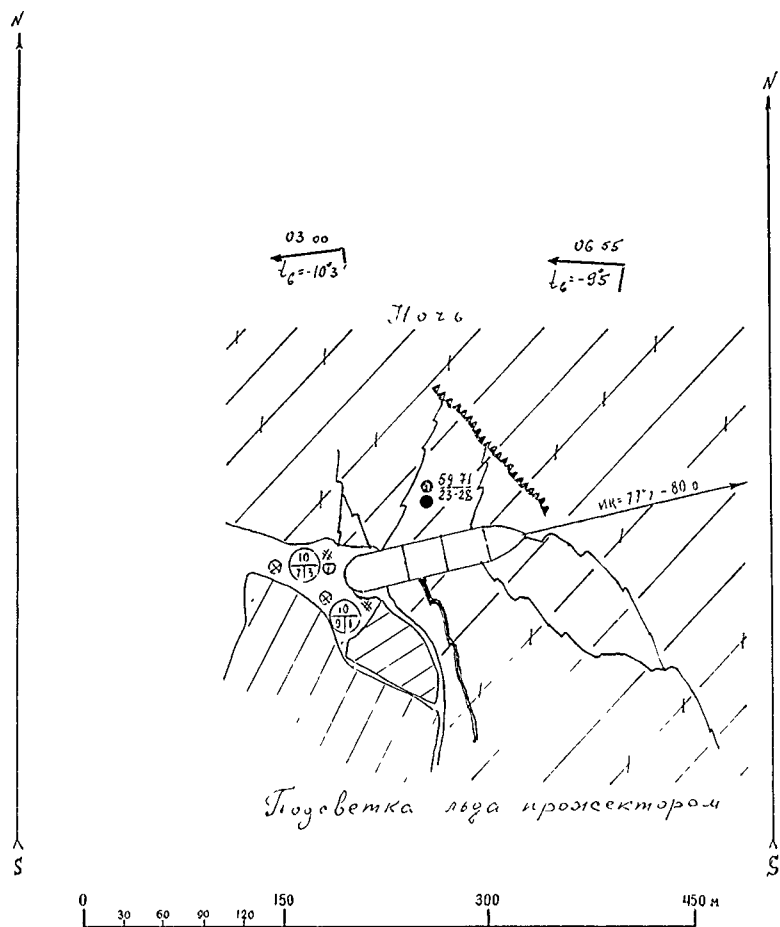
время начала = 11^h 50^m

время конца = 16^h 35^m

СМТ 12^h 50^m

СМТ 17^h 35^m

Figure 76 22 September, ice station 20



ПРОЕКТ - ОБСТАНОВКА

СКОРОСТЬ ДВИЖЕНИЯ ЛЬДА: 0,5 м/с ДАТА: 23 СЕНТЯБРЯ 1989

ПЛОТНОСТЬ ЛЬДА: 0,9

УРОВЕНЬ КОНИКА

$\Phi = 57^\circ 45'$

$\gamma = 6^\circ 57'$

$\lambda = 17^\circ 30'$

$\lambda = 24^\circ 18'$

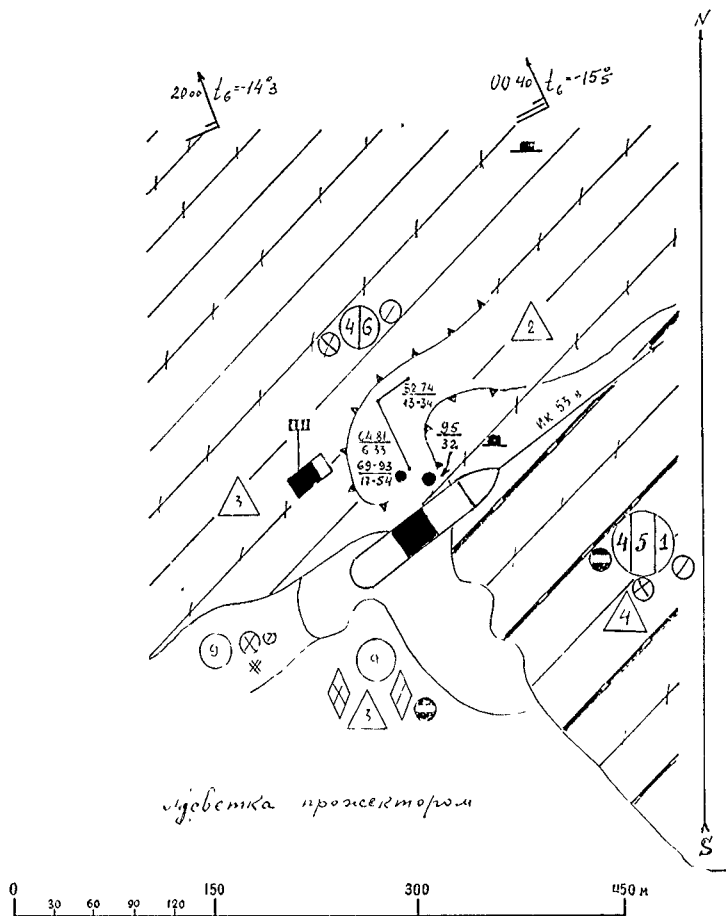
ПРОЕКТ - ОБСТАНОВКА

БЫСТРОТНОСТЬ КОНИКА - 0,65 м/с

ПРОЕКТ - ОБСТАНОВКА

GMT 07:55

Figure 77 23 September ice station 21



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 22 дата: 23-24 сентября 1989

координаты начала координаты конца

$\varphi = 66^{\circ}42'33''$

$\varphi = 66^{\circ}40'00''$

$\lambda = 22^{\circ}49'30''$

$\lambda = 21^{\circ}43'30''$

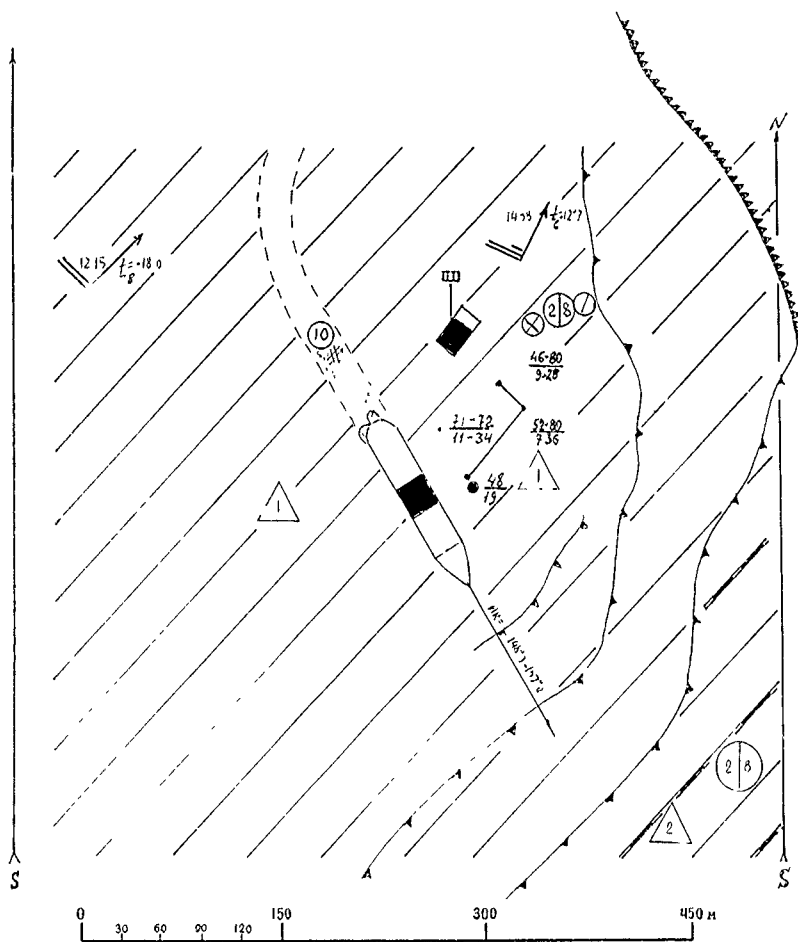
время начала = 20^h00^m

время конца = 00^h40^m

СМГ 21^h00^m

СМГ 01^h40^m

Figure 78 23-24 September ice station 22



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 23 24 сентября 1989

координаты начала координаты конца

$\varphi = 67^{\circ} 23' 35''$

$\varphi = 67^{\circ} 20' 35''$

$\lambda = 21^{\circ} 19' 30''$

$\lambda = 21^{\circ} 18' 30''$

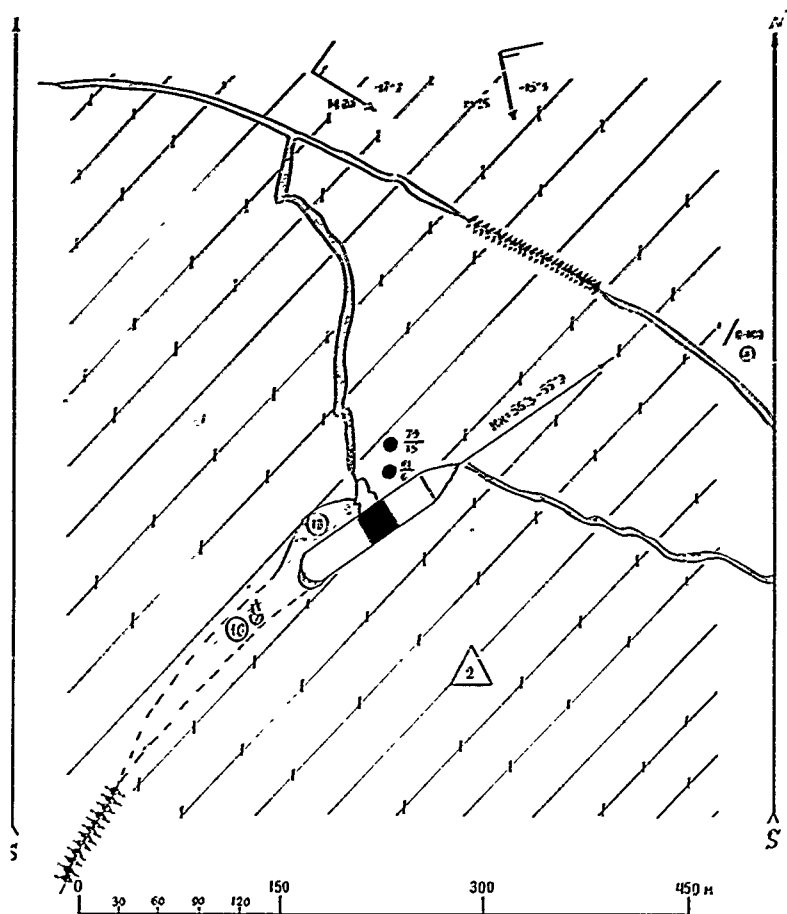
время начала = 10^h 15^m

время конца = 11^h 33^m

GMT 11^h 15^m

GMT 11^h 33^m

Figure 19 24 September, ice station 23



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 25 дата: 25 сентября 1989

координаты начала

координаты конца

$\varphi = 67^{\circ}50'4''$

$\varphi = 67^{\circ}50'5''$

$\lambda = 18^{\circ}46.6''$

$\lambda = 18^{\circ}45''$

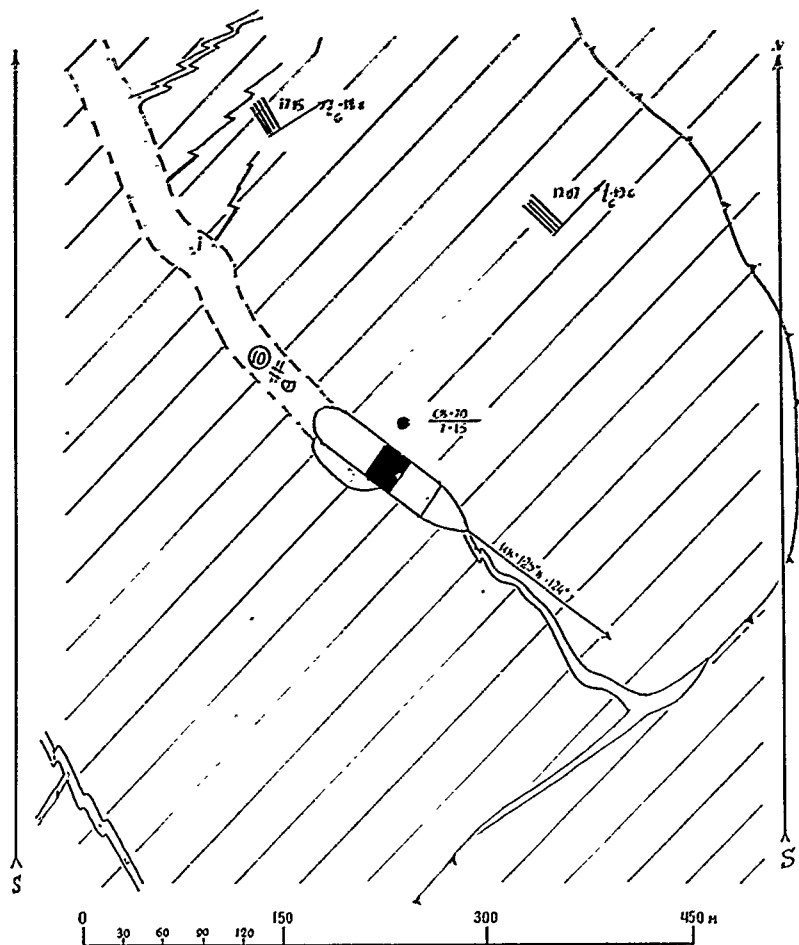
время начала = 14^h00^m

время конца = 15^h25^m

сиг 15^h00^m

сиг 16^h25^m

Figure 81. 25 September, ice station 25.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 27 Дата: 26 сентября 1989

координаты начала

координаты конца

$\varphi = 67^{\circ} 50' 55''$

$\varphi = 67^{\circ} 28' 8''$

$\lambda = 16^{\circ} 18' 9''$

$\lambda = 16^{\circ} 15' 8''$

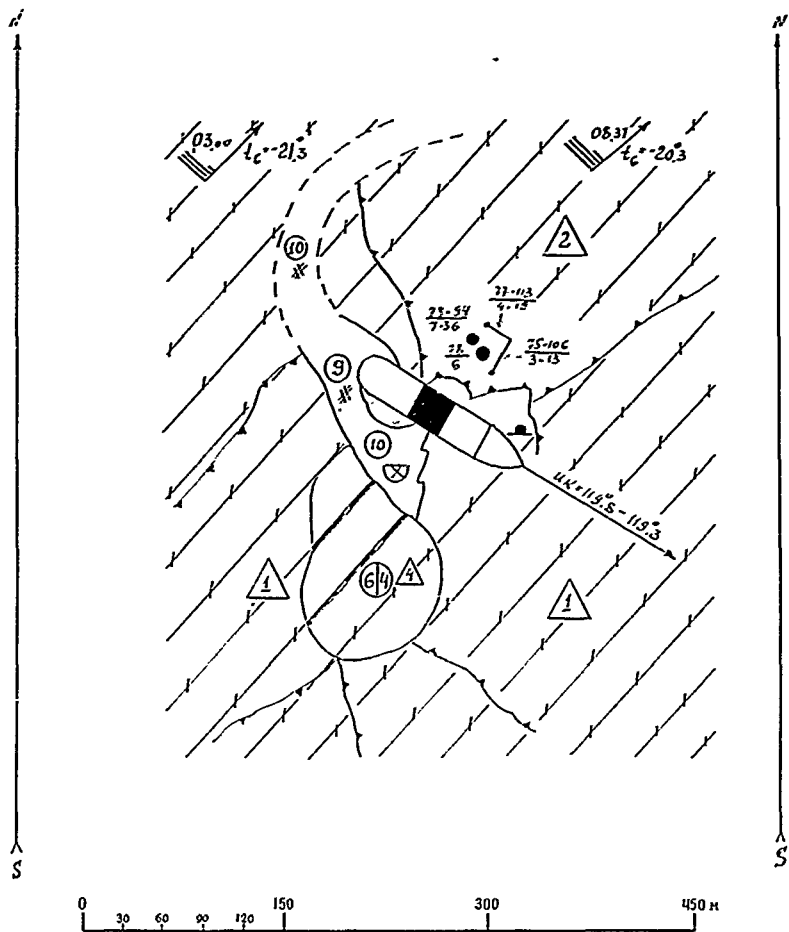
время начала = 17^h 45^m

время конца = 19^h 07^m

GMT 18^h 45^m

GMT 20^h 07^m

Figure 83. 26 September, ice station 27.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 28 дата: 27 сентября 1989

координаты начала координаты конца

$\varphi = 67^{\circ} 21.4'$

$\varphi = 67^{\circ} 18.0'$

$\lambda = 15^{\circ} 02.1'$

$\lambda = 14^{\circ} 59.0'$

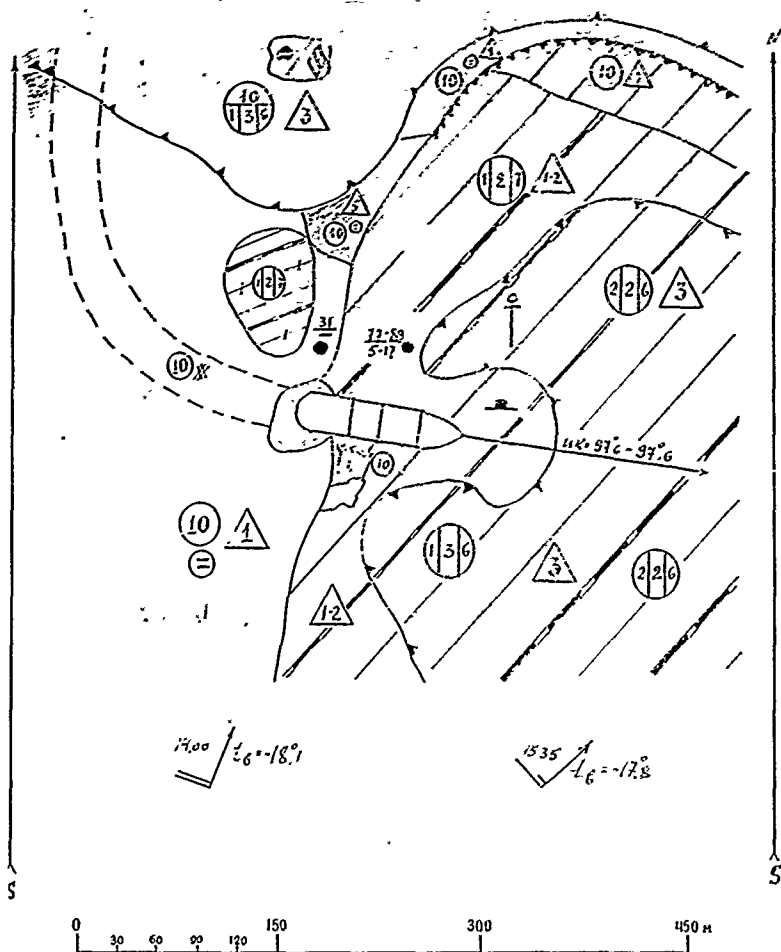
время начала = 05^h 00^m

время конца = 08^h 37^m

СМГ 04^h 00^m

СМГ 09^h 37^m

Figure 84. 27 September, ice station 28.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 29 дата: 27 сентября 1989

координаты начала координаты конца

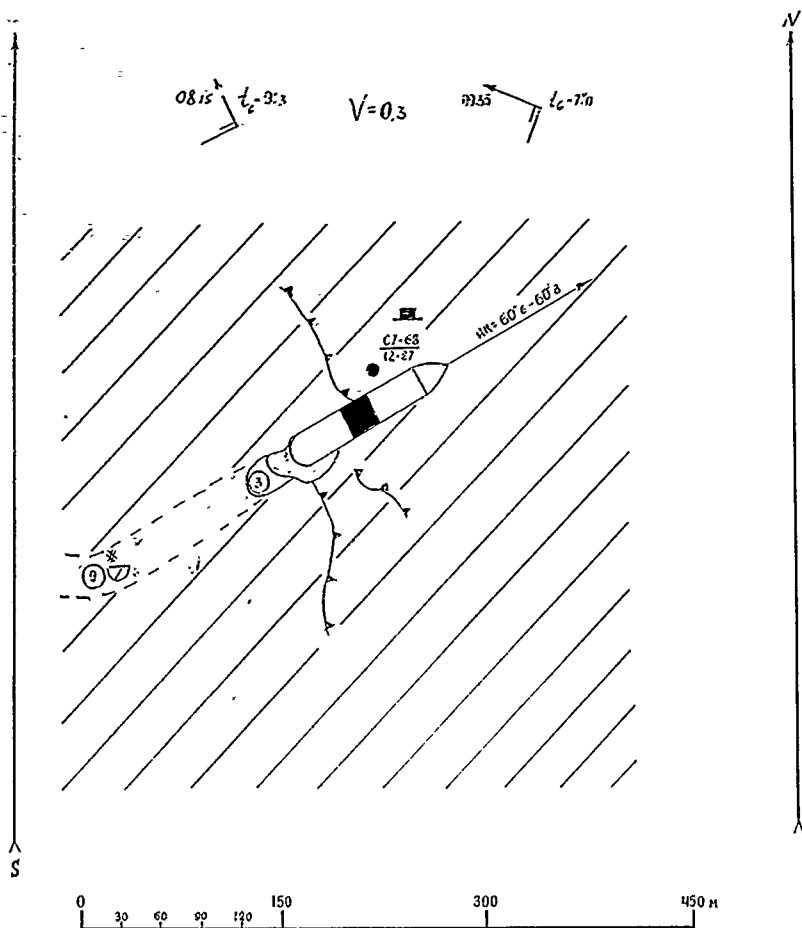
$\varphi = 67^{\circ} 11' 3'' S$ $\varphi = 67^{\circ} 09' 8'' S$

$\lambda = 15^{\circ} 54' 0'' W$ $\lambda = 15^{\circ} 55' 0'' W$

время начала = 14^h 00^m время конца = 15^h 43^m

GMT 15^h 00^m GMT 16^h 43^m

Figure 85. 27 September, ice station 29.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 31 дата: 28 сентября 1989

координаты начала

координаты конца

$\varphi = 66^{\circ} 52' 1'' \text{ S}$

$\varphi = 66^{\circ} 52' 4'' \text{ S}$

$\lambda = 11^{\circ} 28.0' \text{ W}$

$\lambda = 11^{\circ} 26.0' \text{ W}$

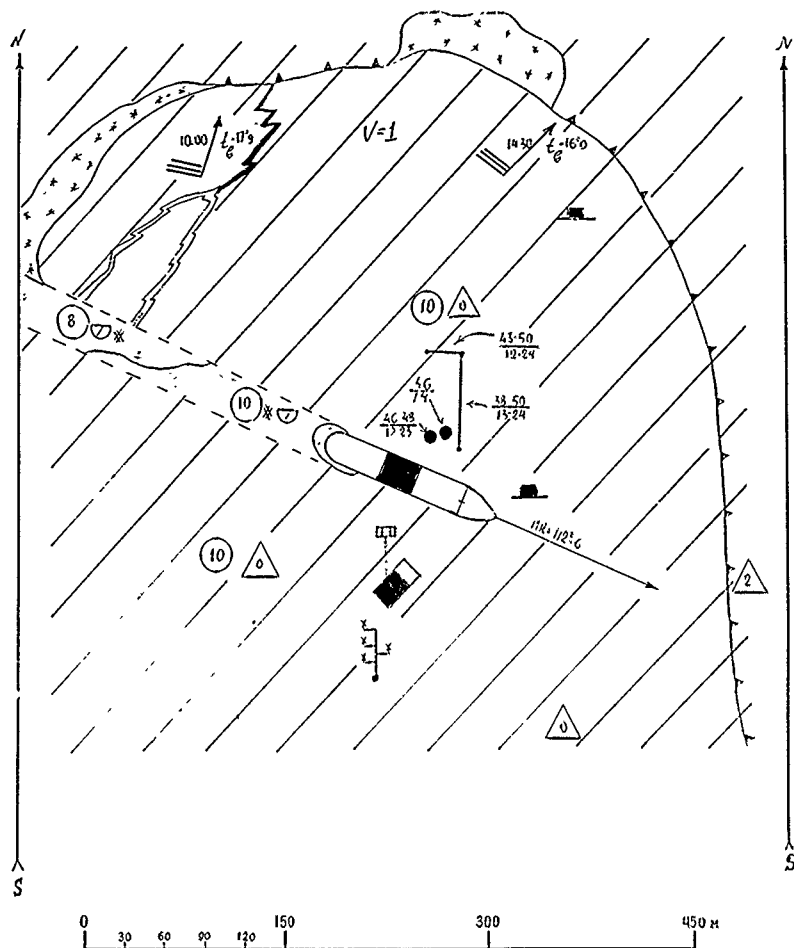
время начала = 08^h 15^m

время конца = 09^h 55^m

СМТ 09^h 15^m

СМТ 10^h 55^m

Figure 87. 28 September, ice station 31.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 34 дата: 29 сентября 1989

координаты начала координаты конца

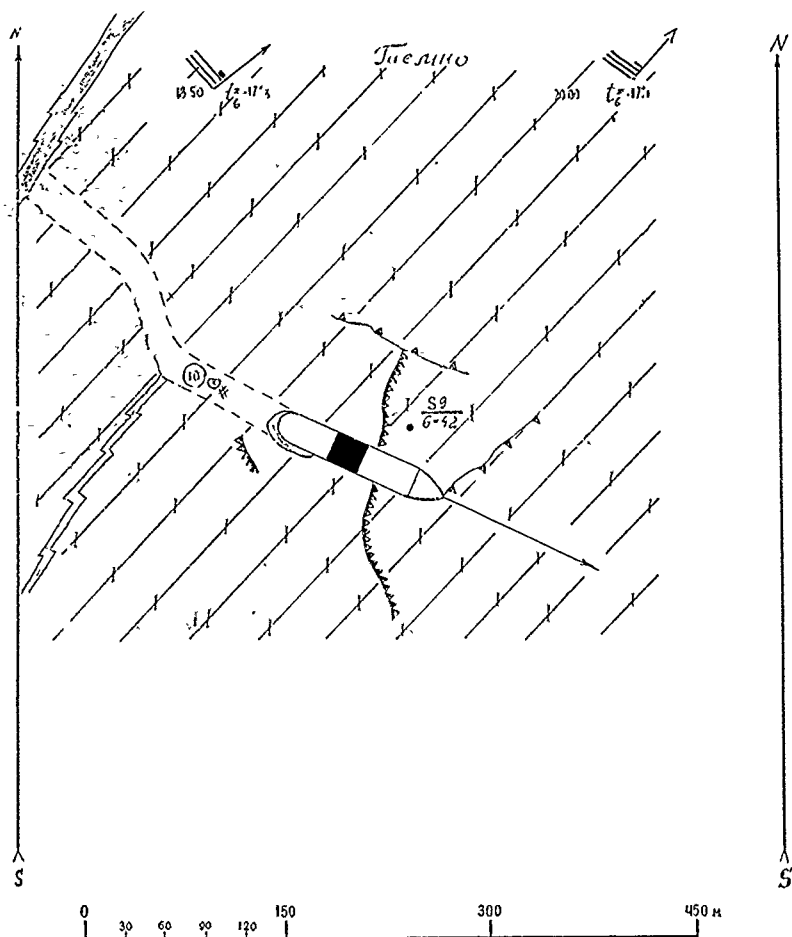
$\varphi = 66^{\circ}21'15''$ $\varphi = 66^{\circ}18'8''$

$\lambda = 07^{\circ}49'17''$ $\lambda = 07^{\circ}46'57''$

время начала = 10^h00^m время конца = 14^h30^m

GMT 10^h00^m GMT 14^h30^m

Figure 90. 29 September, ice station 34.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 35 дата: 29 сентября 1989

координаты начала

координаты конца

$\varphi = 66^{\circ} 10' S$

$\varphi = 66^{\circ} 10' S$

$\lambda = 06^{\circ} 44' W$

$\lambda = 06^{\circ} 44' W$

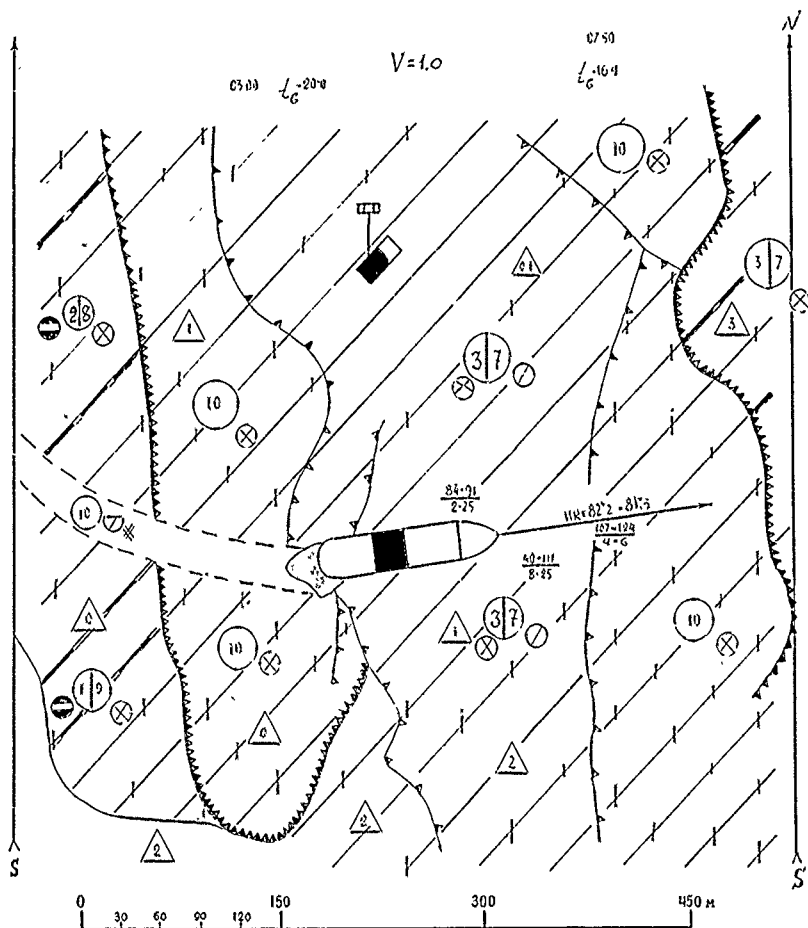
время начала = 18^h 50^m

время конца = 20^h 00^m

СМТ 18^h 50^m

СМТ 20^h 00^m

Figure 91. 29 September, ice station 35.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 36 дата: 30 сентября 1989

координаты начала

координаты конца

$\varphi = 66^{\circ} 02' 0''$ S

$\varphi = 66^{\circ} 00' 0''$ S

$\lambda = 05^{\circ} 54' 0''$ W

$\lambda = 05^{\circ} 29' 9''$ W

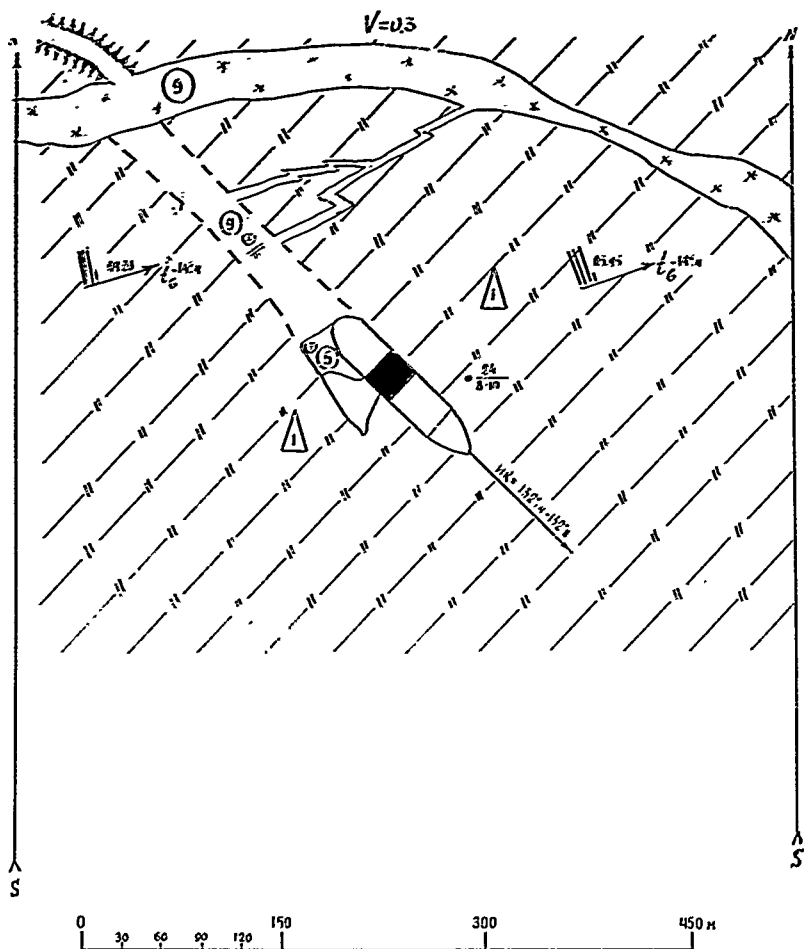
время начала = 07^h 30^m

время конца = 07^h 50^m

GMT 03^h 30^m

GMT 07^h 50^m

Figure 92. 30 September, ice station 36.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 39

дата: 1 октября 1989

координаты начала

координаты конца

$\varphi = 65^{\circ} 32' 2 s$

$\varphi = 65^{\circ} 31' 3 s$

$\lambda = 02^{\circ} 07' 0 w$

$\lambda = 02^{\circ} 05' 3 w$

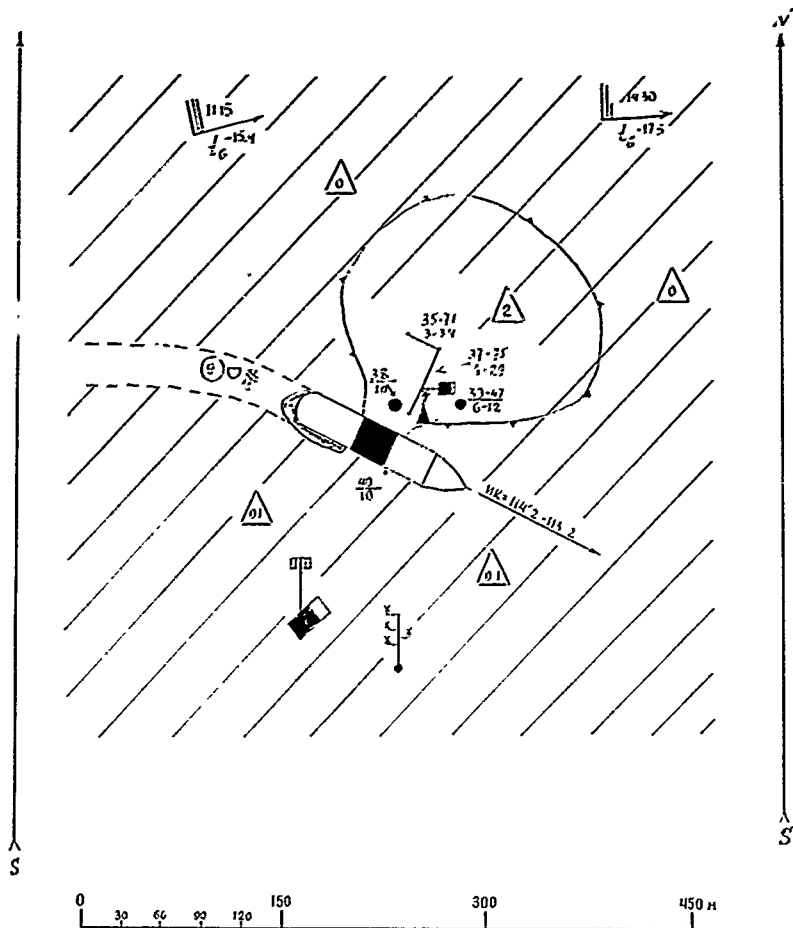
время начала = 04^h 20^m

время конца = 05^h 45^m

БМГ 04^h 20^m

БМГ 05^h 45^m

Figure 94. 1 October, ice station 39.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 40

дата: 1 октября 1989

координаты начала

координаты конца

$\varphi = 65^{\circ} 21' 3''$

$\varphi = 65^{\circ} 20' 5''$

$\lambda = 01^{\circ} 00' 7''$

$\lambda = 00^{\circ} 55' 2''$

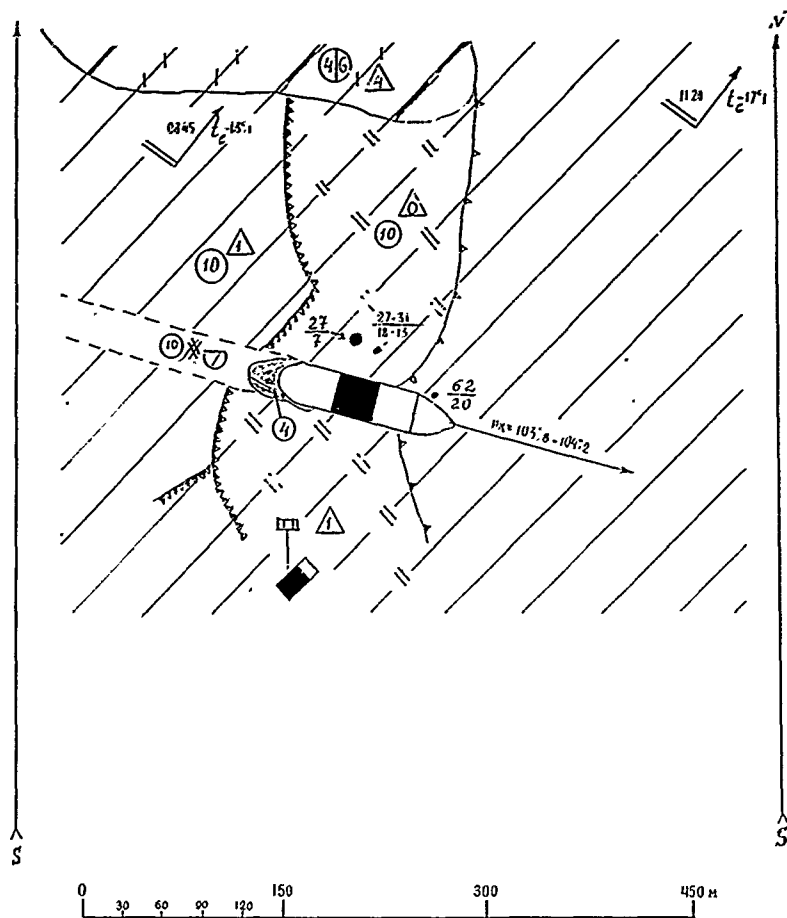
время начала = 11^h 15^m

время конца = 14^h 30^m

GMT 11^h 15^m

GMT 14^h 30^m

Figure 95. 1 October, ice station 40.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 43 дата: 2 октября 1989

координаты начала

координаты конца

$\varphi = 64^{\circ} 59' 8''$

$\varphi = 64^{\circ} 58' 8''$

$\lambda = 02^{\circ} 59' 1''$

$\lambda = 03^{\circ} 00' 5''$

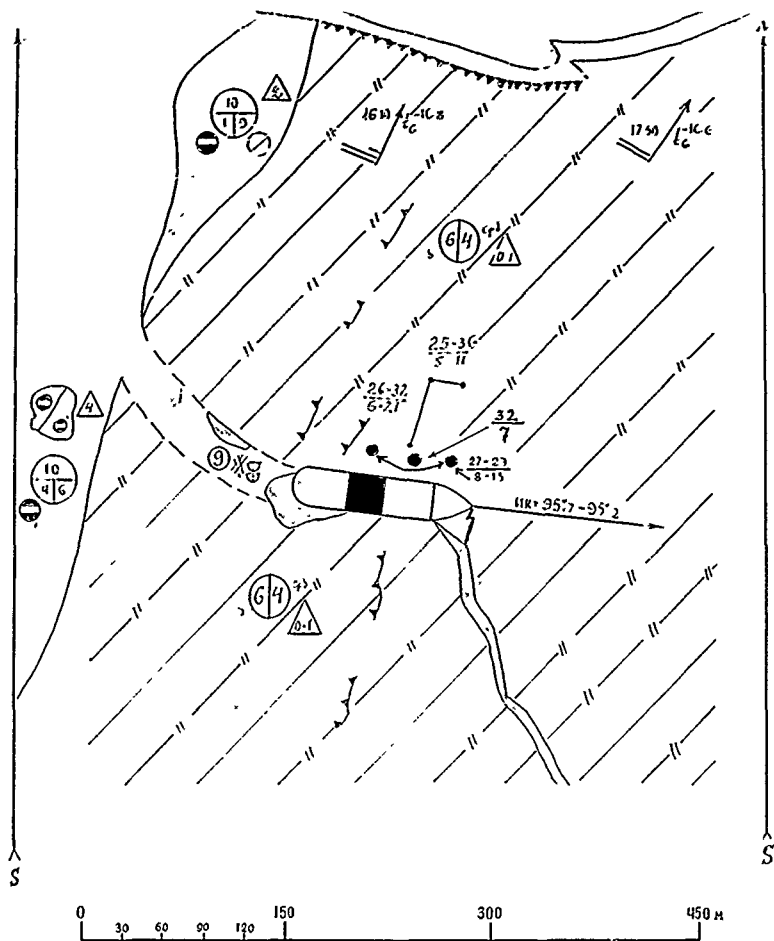
время начала = 08^h 35^m

время конца = 11^h 20^m

GMT 08^h 35^m

GMT 11^h 20^m

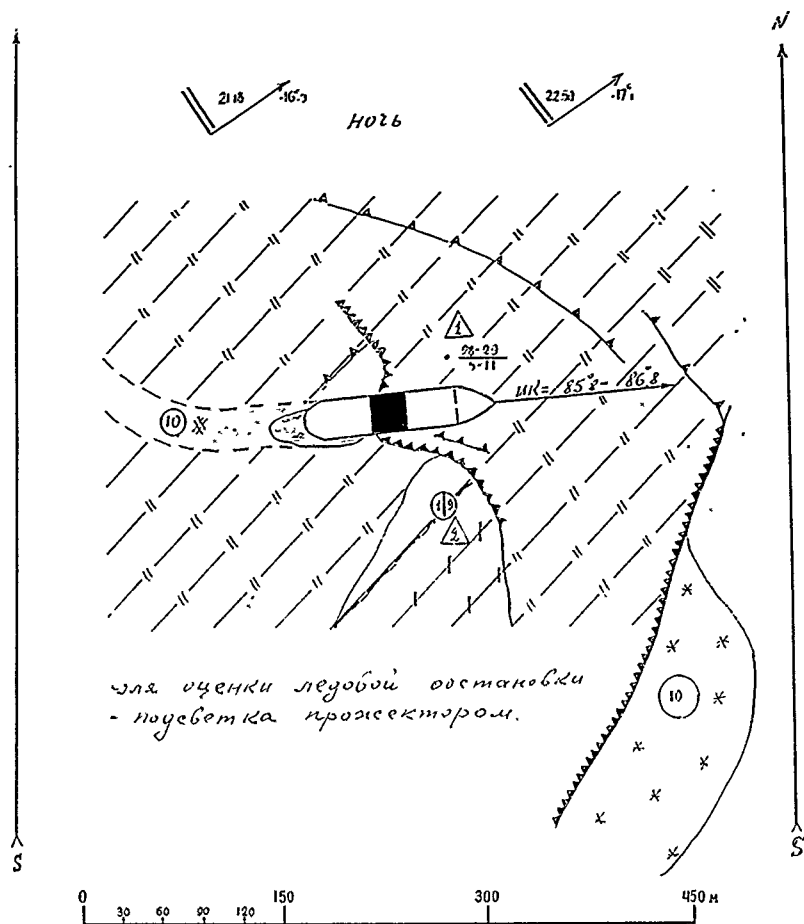
Figure 96. 2 October, ice station 43.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 44	Дата: 2 октября 1989
координаты начала	координаты конца
$\varphi = 65^{\circ}21'4''$	$\varphi = 65^{\circ}20'7''$
$\lambda = 02^{\circ}10'3''$	$\lambda = 02^{\circ}11'0''$
время начала = 16 ^h 10 ^m	время конца = 17 ^h 30 ^m
GMT 16 ^h 10 ^m	GMT 17 ^h 30 ^m

Figure 97. 2 October, ice station 44.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 45 дата: 2 октября 1989

координаты начала координаты конца

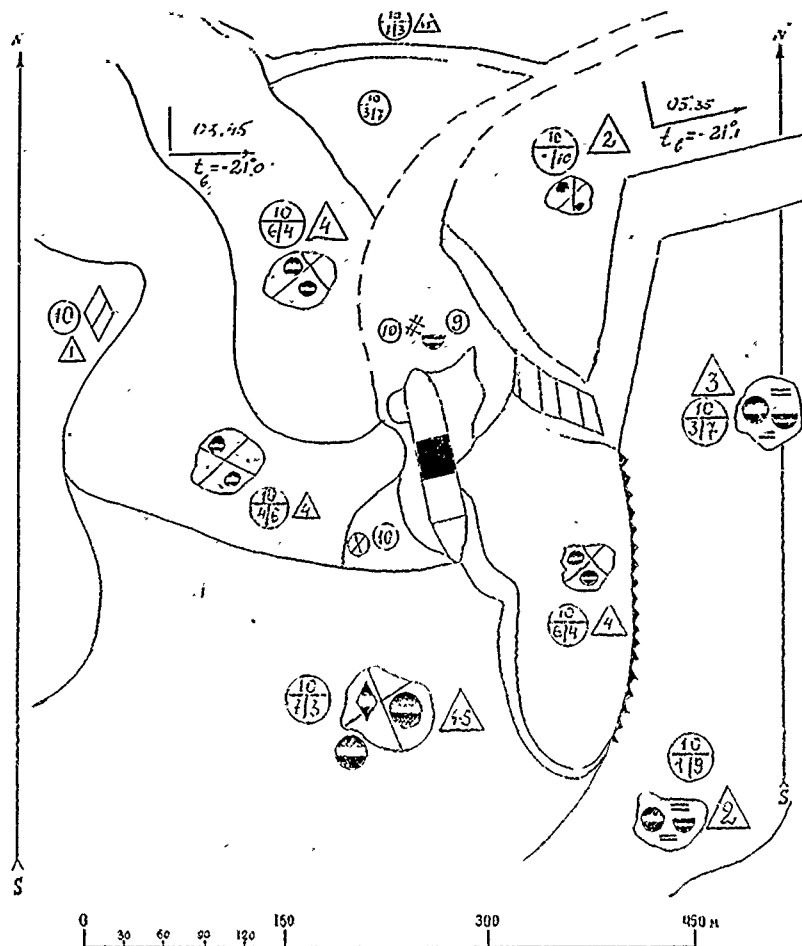
$\varphi = 65^{\circ} 42' 0''$ $\varphi = 65^{\circ} 41' 8''$

$\lambda = 01^{\circ} 17' 4''$ $\lambda = 01^{\circ} 17' 5''$

время начала = 21^h 10^m время конца = 22^h 50^m

GMT 21^h 10^m GMT 22^h 50^m

Figure 98. 2 October, ice station 45.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция

46

дата: 3 октября 1989

координаты начала

координаты конца

$\varphi = 66^{\circ} 03' 2''$

$\varphi = 66^{\circ} 02' 8''$

$\lambda = 00^{\circ} 22' 4''$

$\lambda = 00^{\circ} 22' 7''$

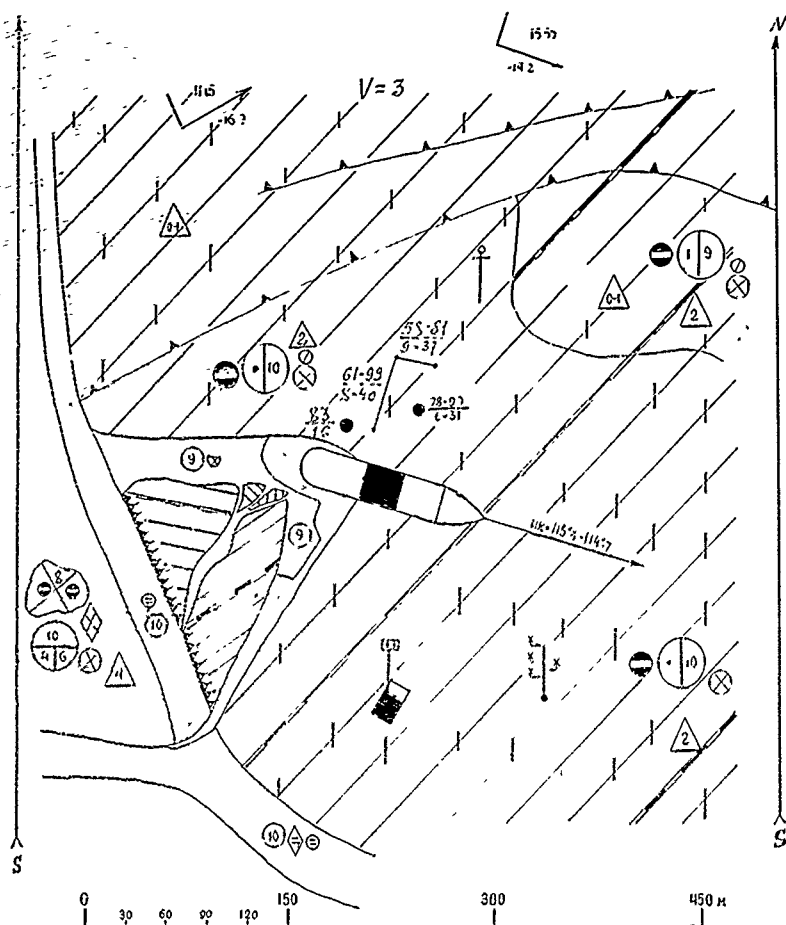
время начала = 03.45^м

время конца = 05.35^м

СМТ 03.45^м

СМТ 05.35^м

Figure 99.3 October, ice station 46.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 47 дата: 3 ОКТАБРЯ 1989

координаты начала

координаты конца

$\varphi = 66^{\circ} 21' 5''$

$\varphi = 66^{\circ} 20' 2''$

$\lambda = 00^{\circ} 26' 7''$

$\lambda = 00^{\circ} 22' 5''$

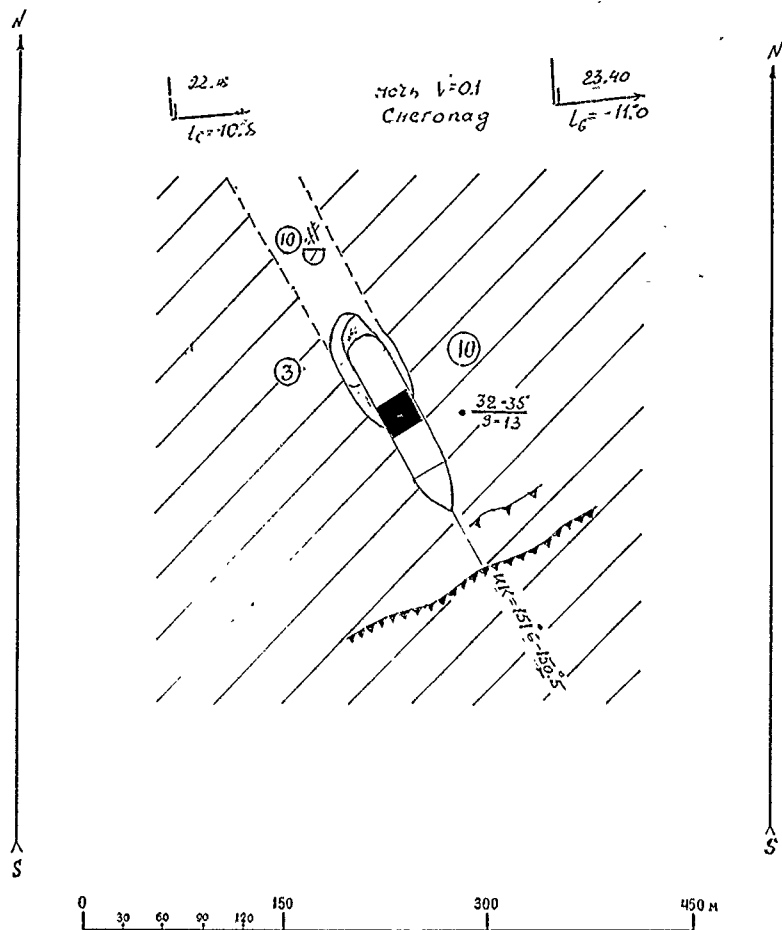
время начала = 11^h 15^m

время конца = 15^h 55^m

GMT 11^h 15^m

GMT 15^h 55^m

Figure 100. 3 October, Ice station 47.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 48 дата: 3 октября 1989

координаты начала

координаты конца

$\varphi = 66^{\circ} 42' 6''$

$\varphi = 66^{\circ} 42' 2''$

$\lambda = 01^{\circ} 16' 3''$

$\lambda = 01^{\circ} 13' 4''$

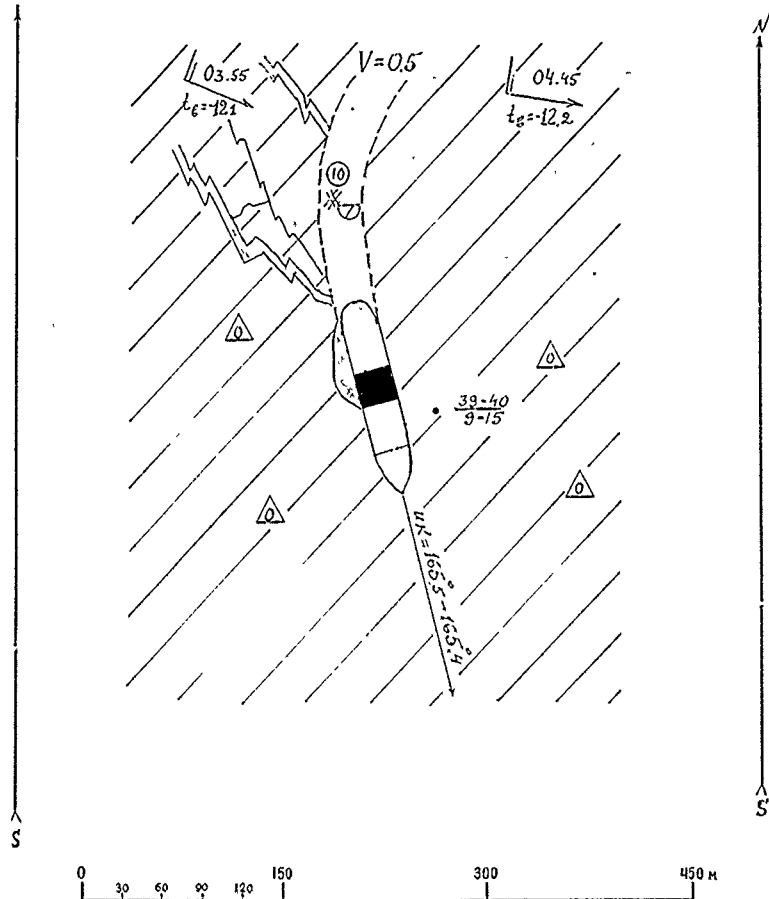
время начала = $22^h 18^{m}$

время конца = $23^h 40^{m}$

СМГ $22^h 18^{m}$

СМГ $23^h 40^{m}$

Figure 101.3 October, ice station 48.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция

49

дата: 4 октября 1989

координаты начала

координаты конца

$\varphi = 66^{\circ} 58' 53''$

$\varphi = 66^{\circ} 58' 53''$

$\lambda = 01^{\circ} 54' 56''$

$\lambda = 01^{\circ} 53' 56''$

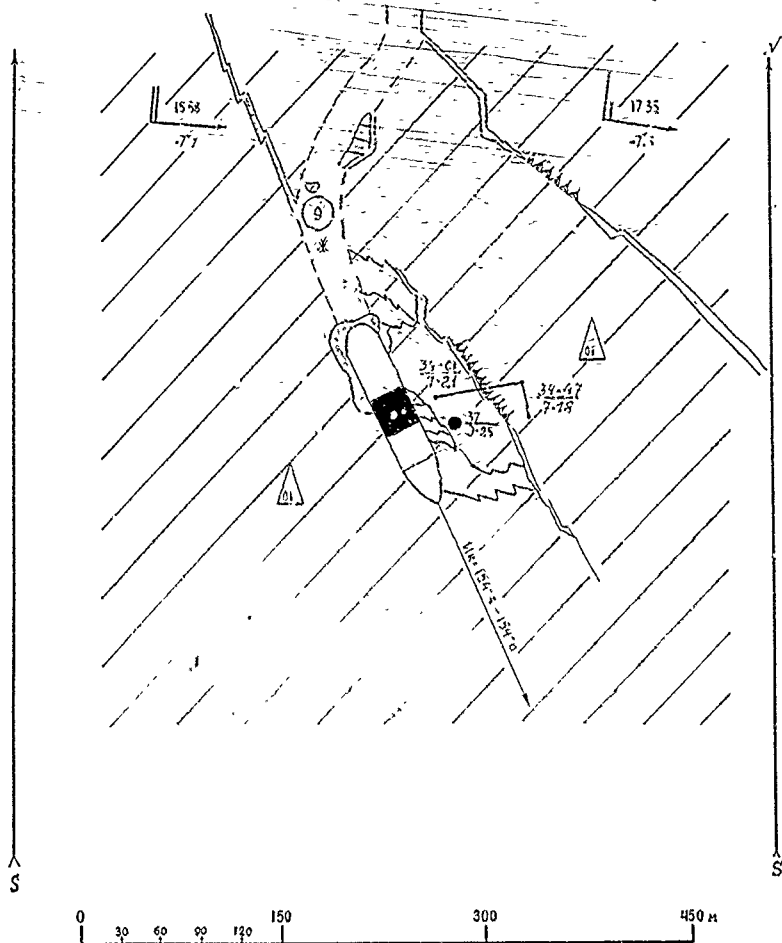
время начала = 03^h55^m

время конца = 04^h50^m

СМТ 03^h55^m

СМТ 04^h50^m

Figure 102.4 October, ice station 49.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 51 дата: 4 октября 1989

координаты начала

$\varphi = 66^{\circ} 50' 5''$

$\lambda = 01^{\circ} 57' 4''$

время начала = 16^h 50^m

СМГ 16^h 50^m

координаты конца

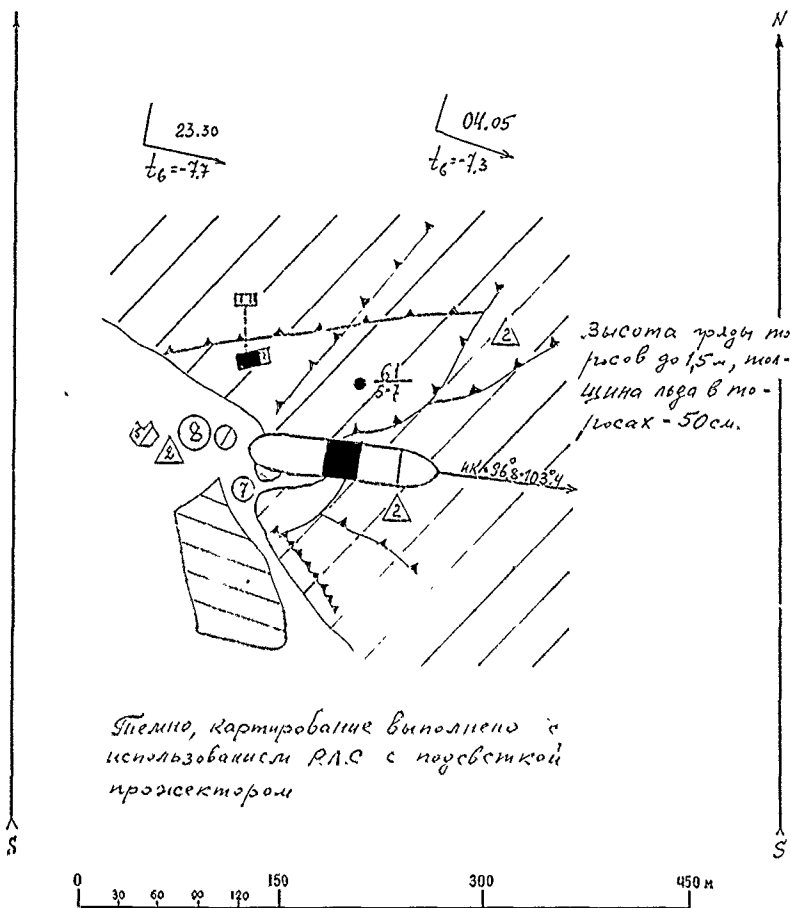
$\varphi = 66^{\circ} 51' 2''$

$\lambda = 01^{\circ} 57' 2''$

время конца = 17^h 35^m

СМГ 17^h 35^m

Figure 103.4 October, ice station 51.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 52 дата: 4-5 октября 1989

координаты начала

координаты конца

$\varphi = 65^{\circ} 20' S$

$\varphi = 65^{\circ} 20' S$

$\lambda = 02^{\circ} 00' W$

$\lambda = 01^{\circ} 57' W$

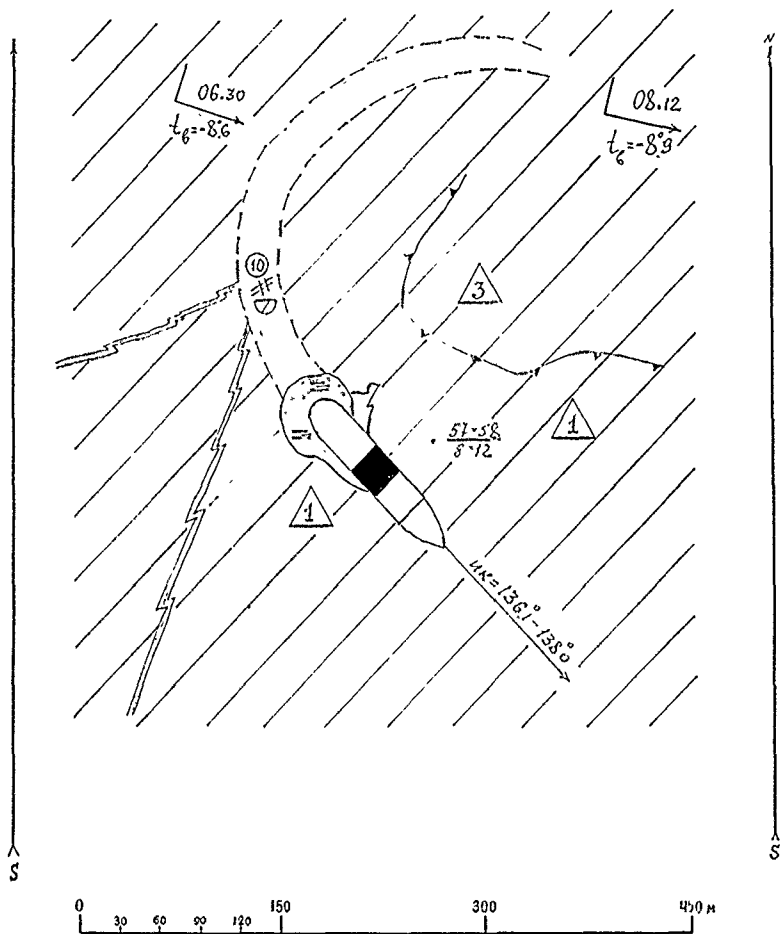
время начала = 25^h 30^m

время конца = 04^h 05^m

GMT 25^h 30^m

GMT 04^h 05^m

Figure 104. 4-5 October, ice station 52.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 53 дата: 5 октября 1989

координаты начала

координаты конца

$\varphi = 65^{\circ} 16' 7''$

$\varphi = 65^{\circ} 17' 1''$

$\lambda = 02^{\circ} 01' 0''$

$\lambda = 02^{\circ} 00' 3''$

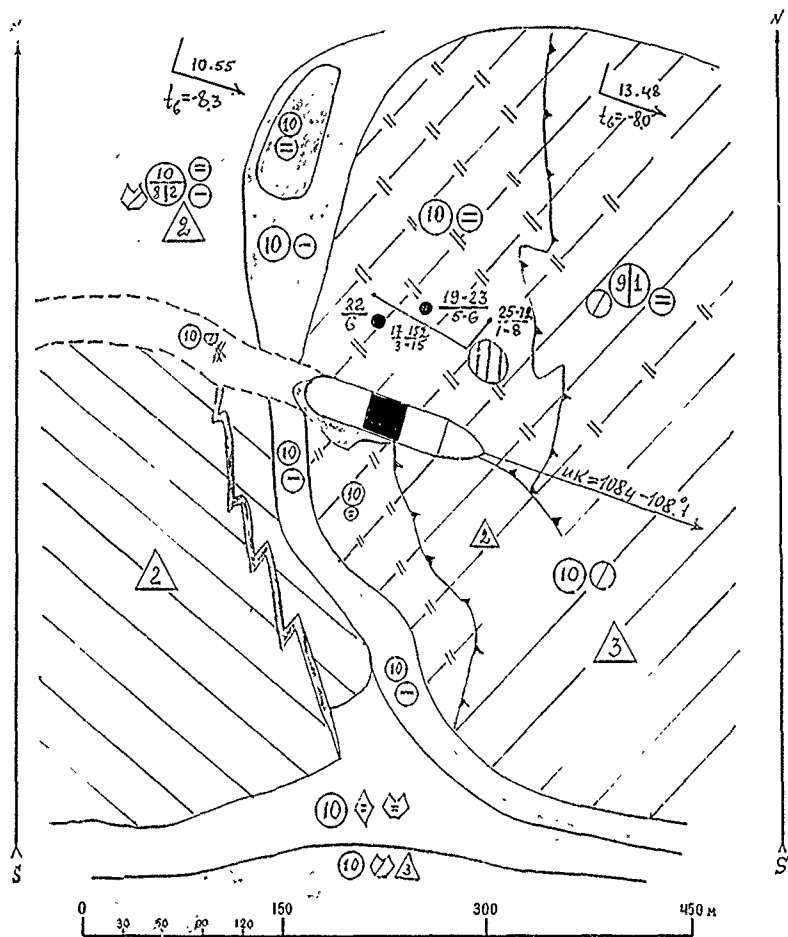
время начала = 06^h 45^m

время конца = 08^h 12^m

GMT 06^h 45^m

GMT 08^h 12^m

Figure 105. 5 October, ice station 53.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 54 дата: 5 октября 1989

координаты начала

координаты конца

$\varphi = 64^{\circ} 59' 1.5''$

$\varphi = 64^{\circ} 59' 5''$

$\lambda = 01^{\circ} 58' 9''$

$\lambda = 01^{\circ} 58' 3''$

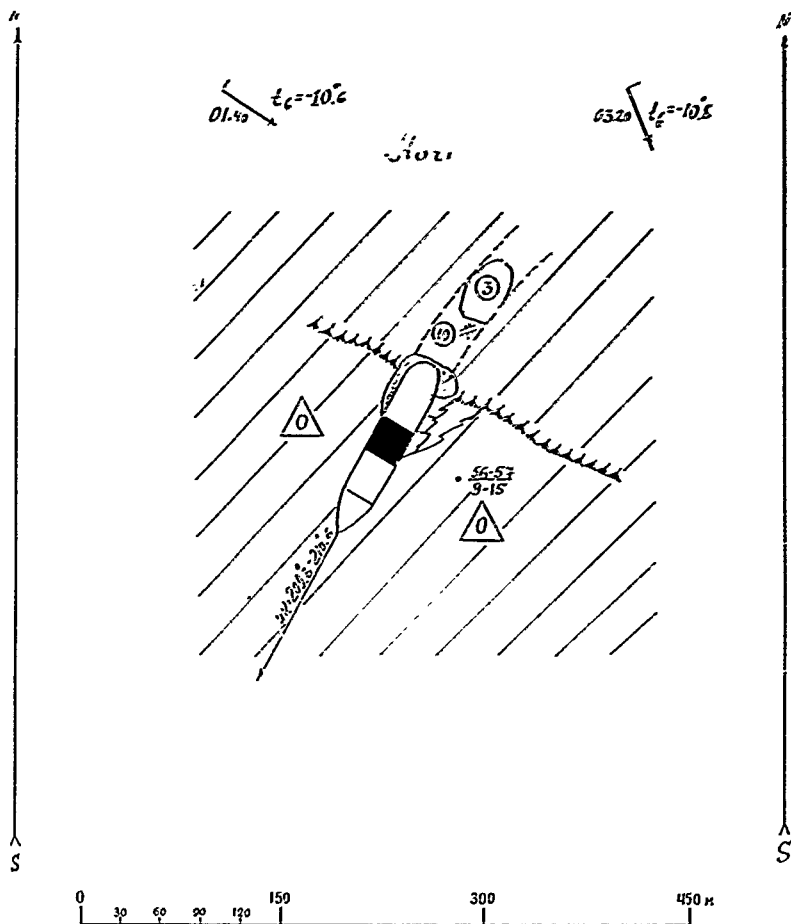
время начала = 10^h 50^m

время конца = 13^h 48^m

ОМТ 10^h 50^m

ОМТ 13^h 48^m

Figure 106. 5 October, ice station 54.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 55 дата: 6 октября 1989

координаты начала координаты конца

$\varphi = 65^{\circ} 46' 35''$

$\varphi = 65^{\circ} 45' 15''$

$\lambda = 02^{\circ} 27' 7''$

$\lambda = 02^{\circ} 26' 15''$

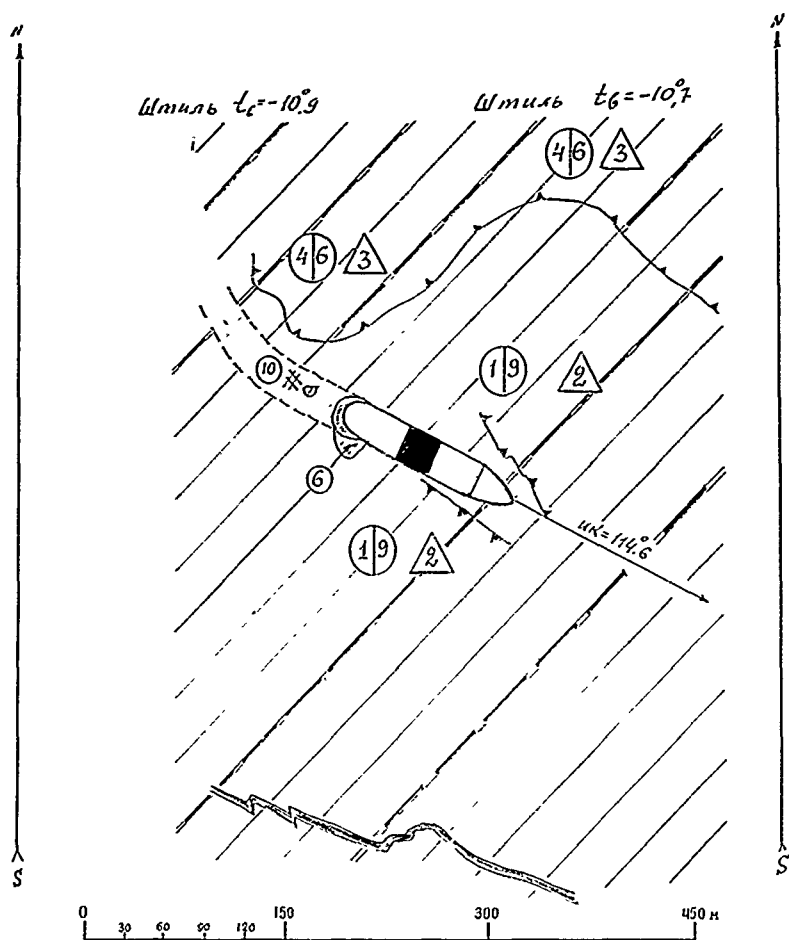
время начала = $01^h 40^m$

время конца = $03^h 20^m$

GMT $01^h 40^m$

GMT $03^h 20^m$

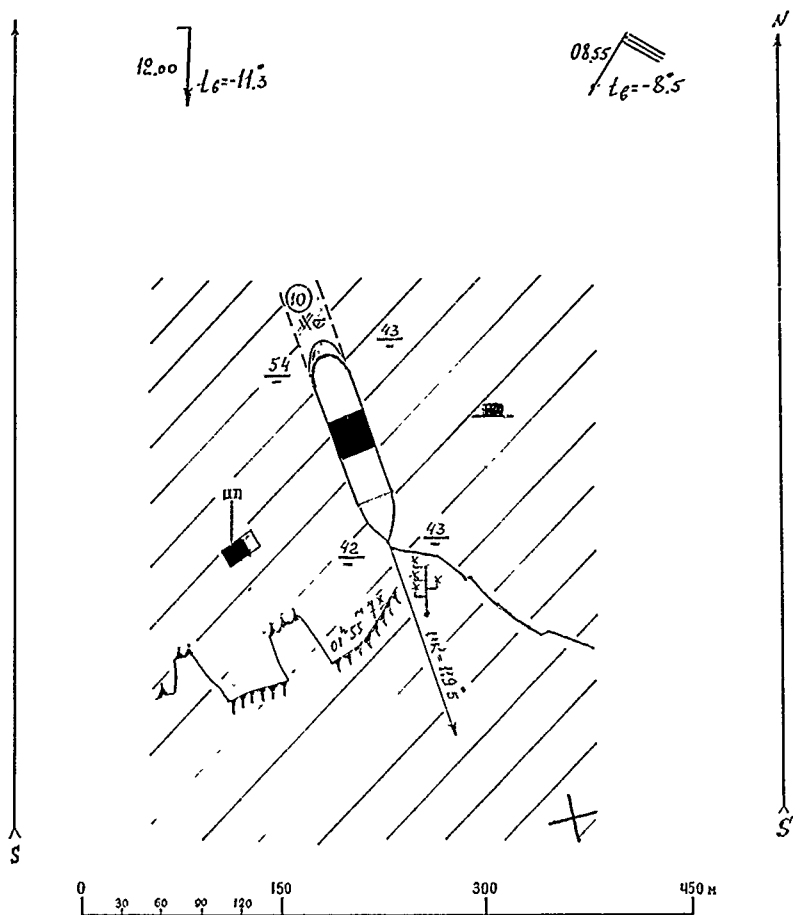
Figure 107. 6 October, ice station 55.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 57	дата: 6 октября 1989
координаты начала	координаты конца
$\varphi = 65^{\circ} 43' 7'' S$	$\varphi = 65^{\circ} 44' 1'' S$
$\lambda = 01^{\circ} 43' 7'' W$	$\lambda = 01^{\circ} 46' 2'' W$
время начала = 10 ^h 42 ^m	время конца = 11 ^h 42 ^m
GMT 10 ^h 42 ^m	GMT 11 ^h 42 ^m

Figure 109. 6 October, ice station 57.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция полигон № 1 дата: 6-7 октября 1989

координаты начала

координаты конца

$\varphi = 65^{\circ} 45' \text{ ш}$

$\varphi = 65^{\circ} 52' \text{ ш}$

$\lambda = 01^{\circ} 45' \text{ в}$

$\lambda = 01^{\circ} 51' \text{ в}$

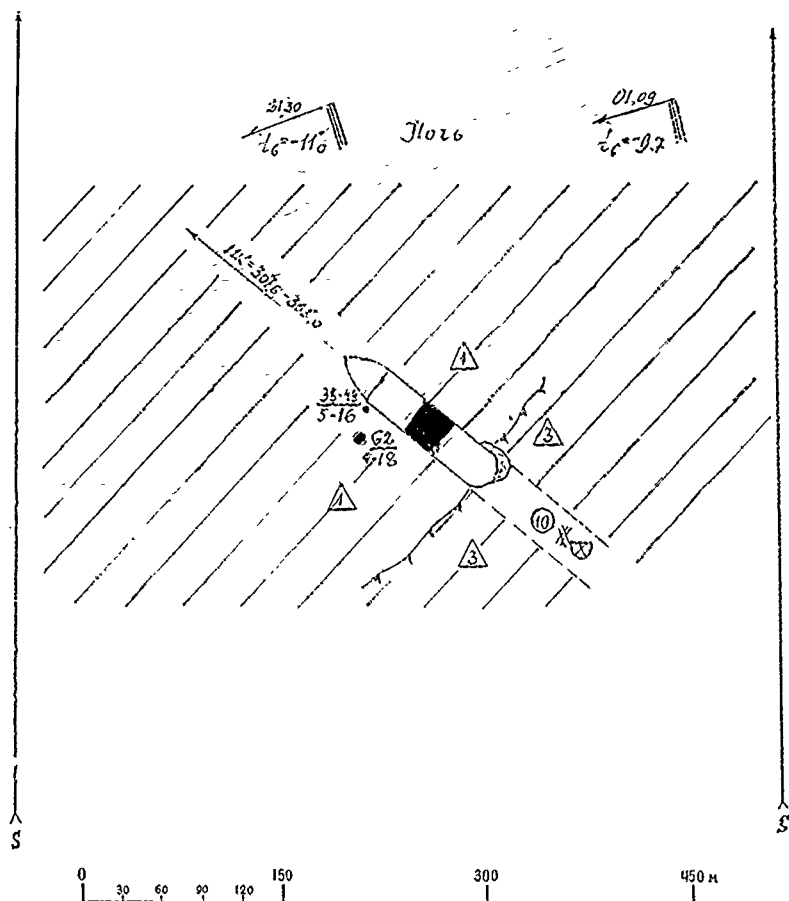
время начала = 12^ч 15^м

время конца = 08^ч 55^м

ОМГ 12^ч 15^м

GMT 08^ч 55^м

Figure 110. 6-7 October, mesopolygon 1.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 116 дата: 18-19 октября 1989

координаты начала

координаты конца

$\varphi = 65^{\circ} 20' .8 \text{ S}$

$\varphi = 65^{\circ} 25' .7 \text{ S}$

$\lambda = 02^{\circ} 07' .7 \text{ W}$

$\lambda = 02^{\circ} 15' .5 \text{ W}$

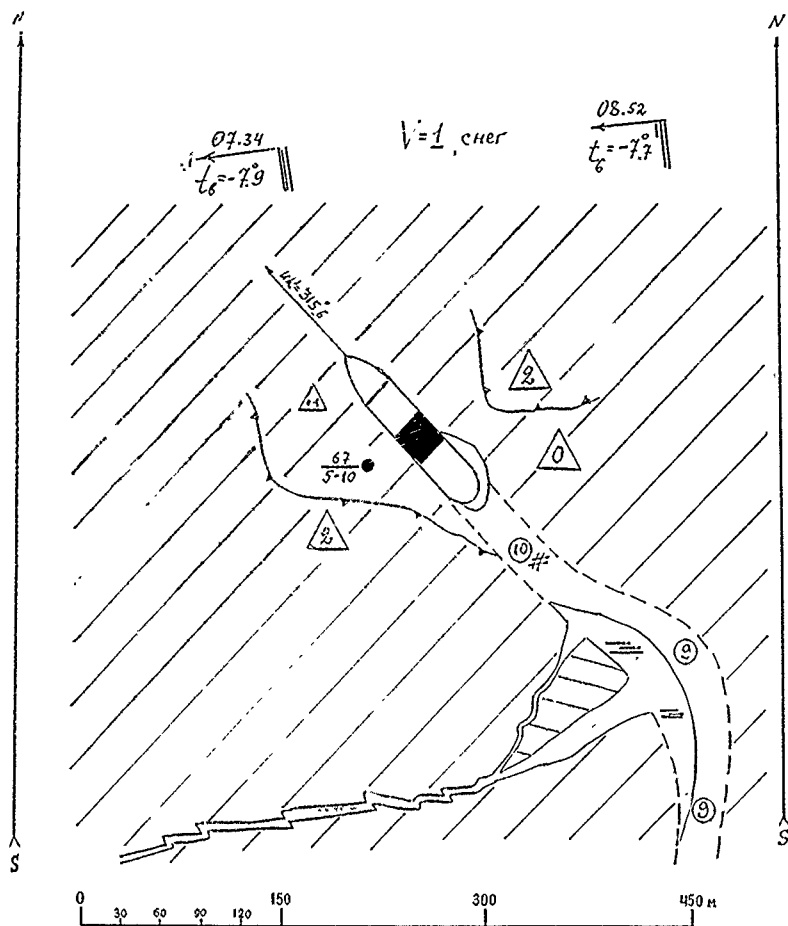
время начала = 21^h 30^m

время конца = 01^h 09^m

GMT 21^h 30^m

GMT 01^h 09^m

Figure 112. 18-19 October, ice station 116.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 117 дата: 19 Октября 1989

координаты начала

координаты конца

$\varphi = 64^{\circ} 57' 8.5''$

$\varphi = 64^{\circ} 58' 2.5''$

$\lambda = 02^{\circ} 57' 2''$ W

$\lambda = 02^{\circ} 59' 1''$ W

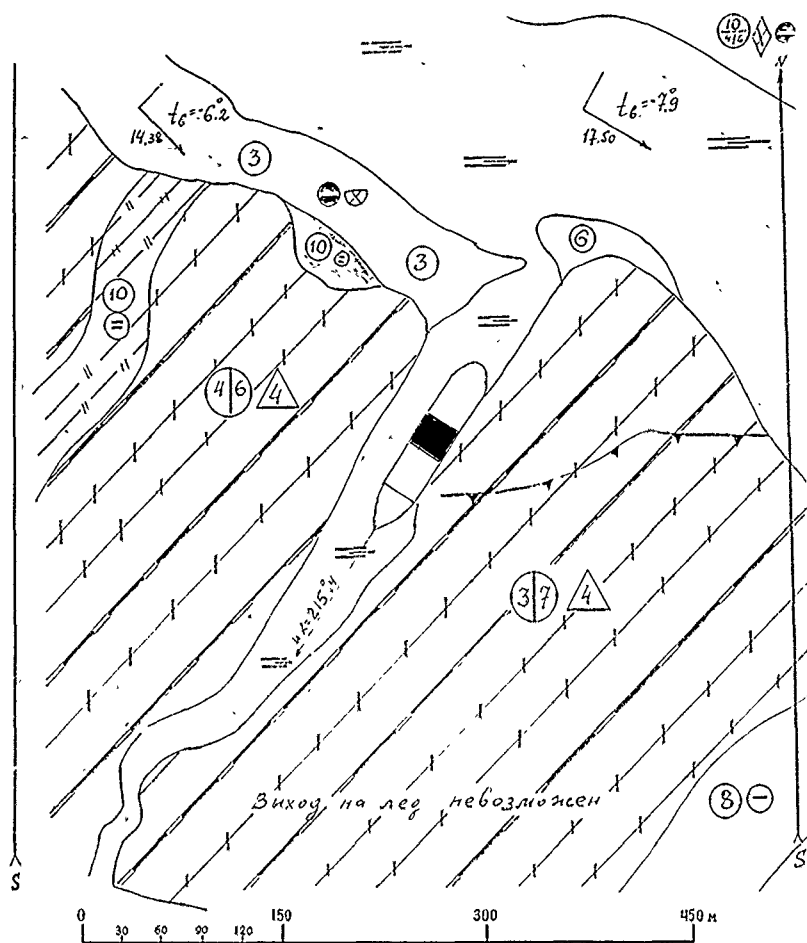
время начала = 07^h 34^m

время конца = 08^h 52^m

СМГ 07^h 34^m

СМГ 08^h 52^m

Figure 113. 19 October, ice station 117.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 118 дата: 19 октября 1989

координаты начала

координаты конца

$\varphi = 64^{\circ} 54' 15''$

$\varphi = 64^{\circ} 54' 15''$

$\lambda = 05^{\circ} 48' 30''$

$\lambda = 05^{\circ} 44' 30''$

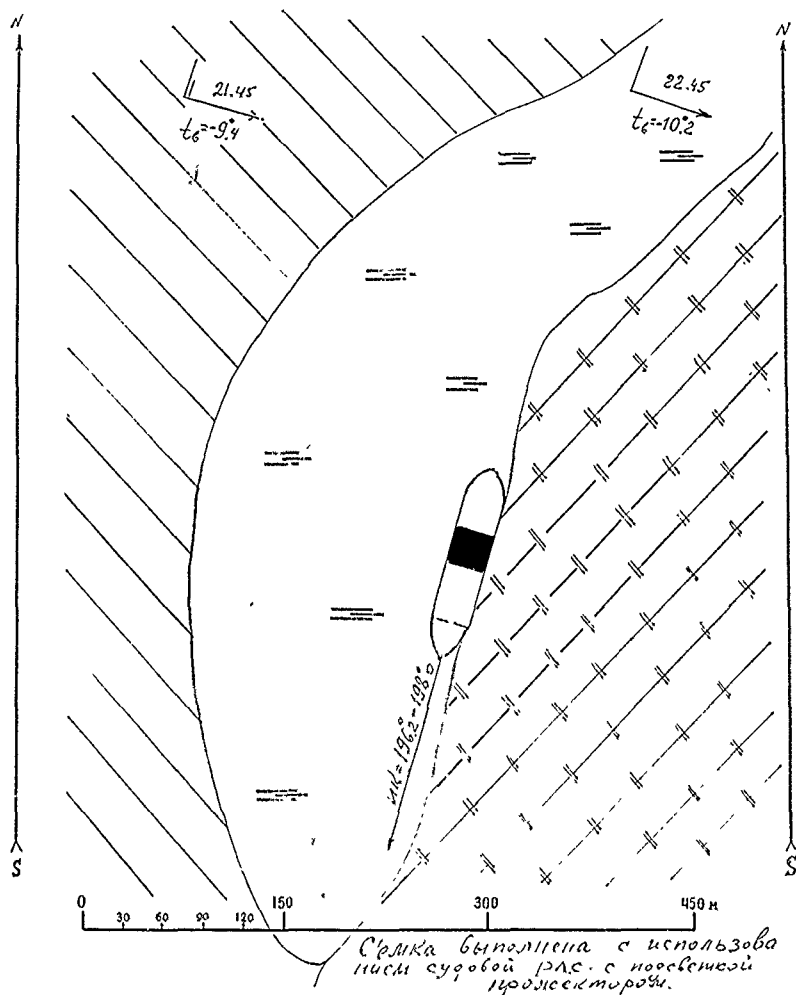
время начала = 14^h 38^m

время конца = 17^h 50^m

6МГ 14^h 38^m

6МГ 17^h 50^m

Figure 114. 19 October, ice station 118.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 119 дата: 19 октября 1989

координаты начала

координаты конца

$\varphi = 64^{\circ} 12.9' S$

$\varphi = 64^{\circ} 13.0' S$

$\lambda = 04^{\circ} 38.8' W$

$\lambda = 04^{\circ} 37.0' W$

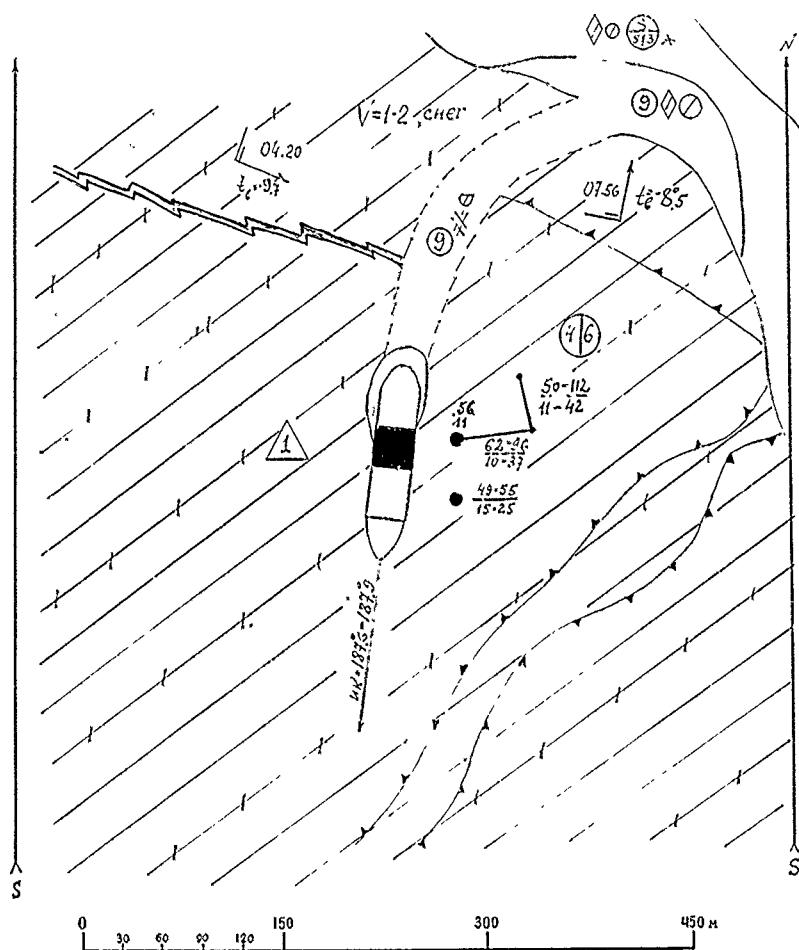
время начала = 21^h 45^m

время конца = 22^h 45^m

GMT 21^h 45^m

GMT 22^h 45^m

Figure 115. 19 October, ice station 119.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 120

дата: 20 ОКТАБРЯ 1989

координаты начала

координаты конца

$\varphi = 63^{\circ} 50.5' S$

$\varphi = 63^{\circ} 49.8' S$

$\lambda = 05^{\circ} 27.1' W$

$\lambda = 05^{\circ} 26.3' W$

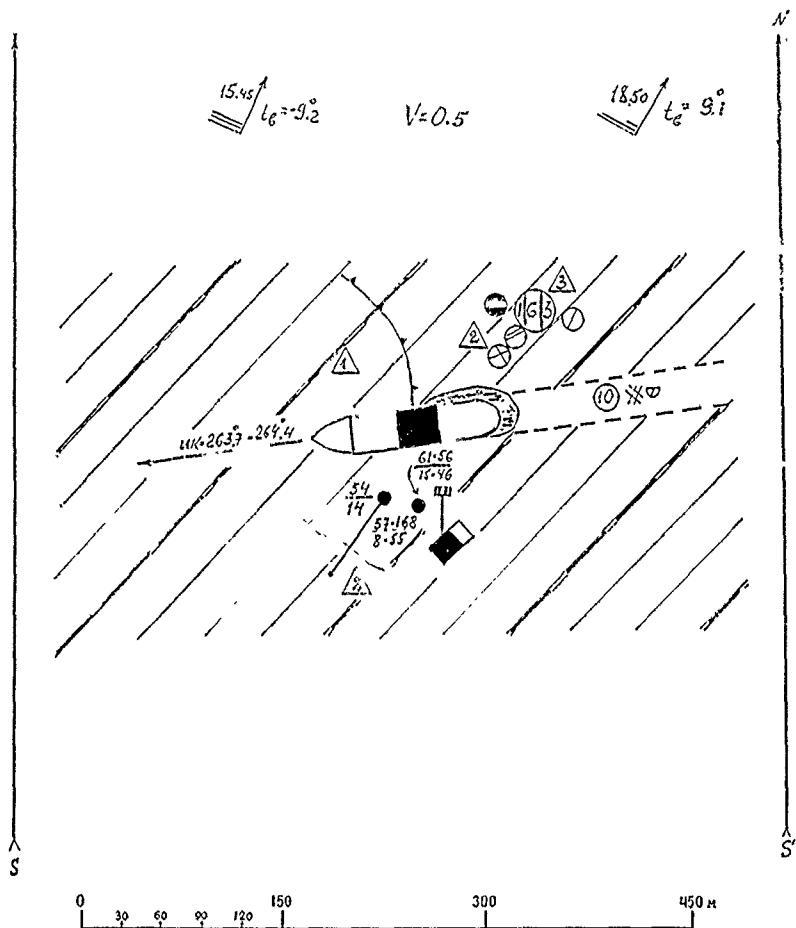
время начала = 04^h20^m

время конца = 07^h56^m

GMT 04^h20^m

GMT 07^h56^m

Figure 116. 20 October, ice station 120.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 121 дата: 20 октября 1989

координаты начала

координаты конца

$\varphi = 65^{\circ} 02' . 5$

$\varphi = 62^{\circ} 57' . 5$

$\lambda = 07^{\circ} 02' . 1$ W

$\lambda = 06^{\circ} 53' . 3$ W

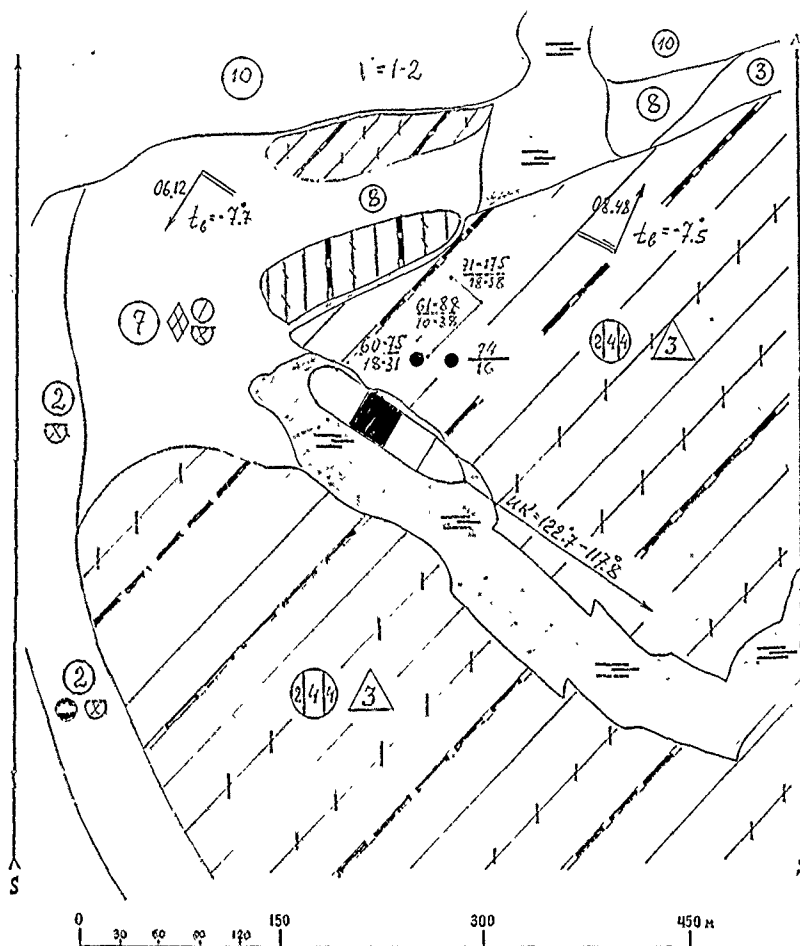
время начала = 16^h 00^m

время конца = 18^h 50^m

GMT 16^h 00^m

GMT 18^h 50^m

Figure 117. 20 October, ice station 121.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 122 дата: 21 ОКТЯБРА 1989

координаты начала

координаты конца

$\varphi = 62^{\circ}19'1''$

$\varphi = 62^{\circ}18'5''$

$\lambda = 08^{\circ}27'8''$

$\lambda = 08^{\circ}30'0''$

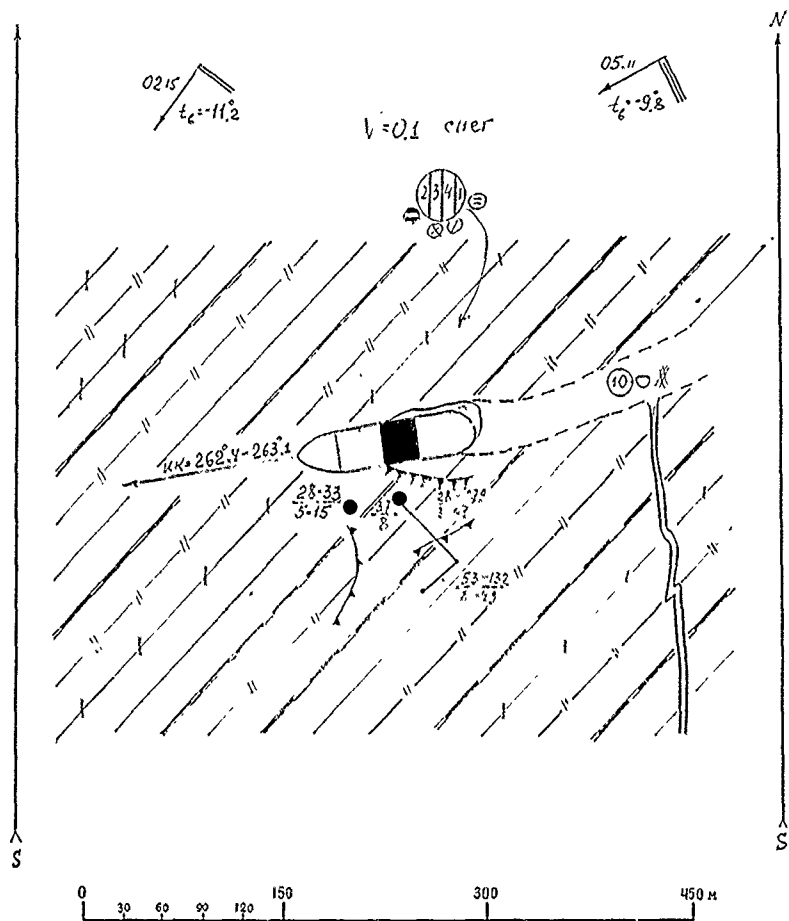
время начала = 06^h12^m

время конца = 08^h48^m

СМГ 06^h12^m

СМГ 08^h48^m

Figure 118. 21 October, ice station 122.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 124 дата: 22 октября 1989

координаты начала

координаты конца

$\varphi = 60^{\circ} 53' \text{ с. ш.}$

$\varphi = 60^{\circ} 55' \text{ с. ш.}$

$\lambda = 11^{\circ} 25' \text{ з. д.}$

$\lambda = 11^{\circ} 27' \text{ з. д.}$

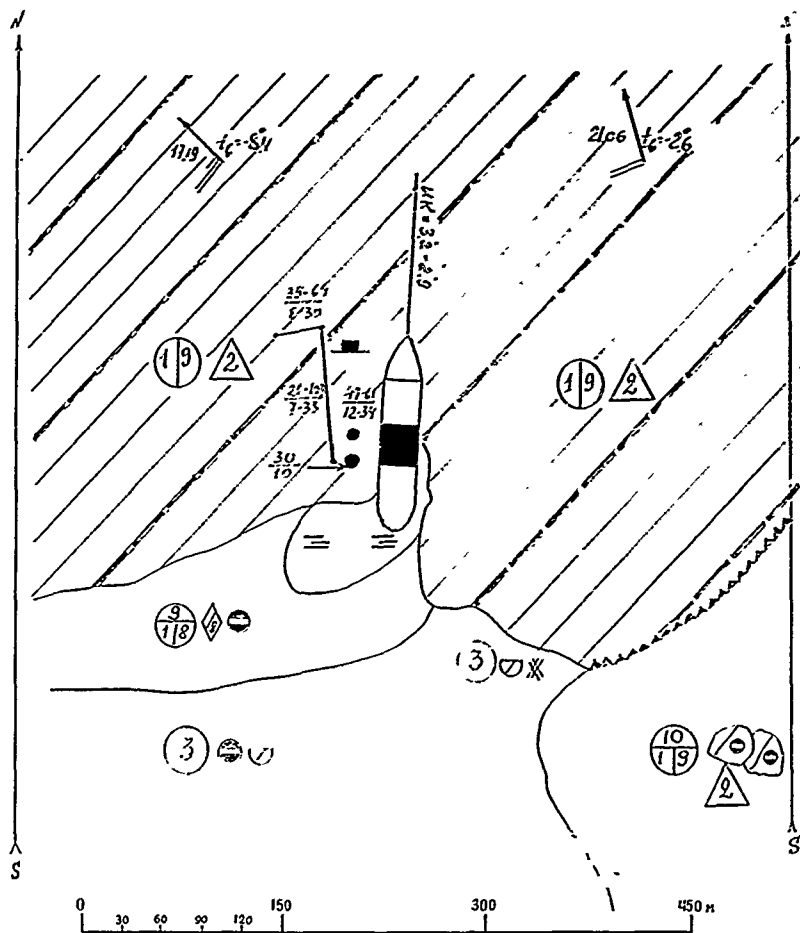
время начала = 02^h 15^m

время конца = 05^h 39^m

СМТ 02^h 15^m

СМТ 05^h 39^m

Figure 120. 22 October, ice station 124.



ЛЕДОВАЯ ОБСТАНОВКА

Океанографическая станция № 125 дата: 22 октября 1989

координаты начала координаты конца

$\varphi = 59^{\circ} 51' .3 S$

$\varphi = 59^{\circ} 50' .0 S$

$\lambda = 11^{\circ} 55' .4 W$

$\lambda = 11^{\circ} 58' .6 W$

время начала = 17^h 10^m

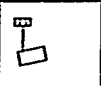
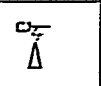
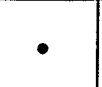
время конца = 21^h 06^m

СМГ 17^h 10^m

СМГ 21^h 06^m

Figure 121. 22 October, ice station 125.

PAYNE COHEN
SPECIFIC DETERMINATIONS

MARK-WHITE		MARK-COLOUR	CHARACTERISTIC
1	2	3	
1			ICE AS FORMED, STATION NO. 5 AND QUANTITATIVE CLIMATE 412 IN 5 KNOTS IN AS FORMED, turning at the beginning of station 412 at end 412
2			FROM 20 KM, APPROXIMATE CLIMATE Canal in the ice, made by the ship
3			ULTRASONIC ANEMOMETER THERMOMETER (KALIS DENKI FRG) AUSTRIAN MEASUREMENTS (PPF)
4			ACROS BUOY (FRG) MISTO STATIONARY APPROPRIATE (PPF)
5			RADIATION MEASUREMENTS (FRG) MISTO MEASUREMENTS OF RADIATION (PPF)
6			Thickness profile (USA) Profile thickness of ice and snow cover (CIA)
7			Ice core site (USA) MISTO STATIONARY APPROPRIATE (PPF)

№	1	2	3
8	○	●	Место обнаружения ЛС в секторе АЛС (СССР) ke cr-2 2-12 (USSR)
9	□	■	Critical site (USA) Место обнаружения критиче- ского ЛС (USA)
10			РЕПЕРНАЯ ВЫСОТА И GRADIENT TOWER (USSR)
11			ДАННЫЕ ДЕФОРМАЦИИ АРАБСКОГО (СССР) Ice deformation measure (USSR)
12			ПОКАЗАТЕЛИ АЛБЕДО (СССР) Albedo measurements (U
13	□	■	Место осмотра ЛСОВ АЛС в секторе ЦЕНТРАЛЬНОГО АЛС 10-16 ОКТЯБРА Investigation of L and S profiles in the ice 13-16 (USSR)
14	✱	✱	Место осмотра ЛСОВ АЛС в секторе ЦЕНТРАЛЬНОГО АЛС 10-16 ОКТЯБРА (СССР) Investigation of L and S in the ice 10-16 October (U
15	+	+	Место для определения температуры таяния льда (СССР) Ice melting investigation

Ice station Океанографическая станция № 445

Date
дата, 19 сентября 1989

КООРДИНАТИ КОМП'А

$$\varphi = 61^{\circ} 49' 55''$$

Ending location

$\lambda = 52^{\circ}49.8 \text{ W}$

время окончания = 19^h 30^m Ending time
LMT 20^h 30^m

Legend for ice station maps.

PHASE DESIGNATION SPECIFIC DENOMINATIONS

ТИП ОУИ	ХАРАКТЕРИСТИКА
2	3
	НЧ. Аз. Станция. Излучает вол. в диапазоне частотной станции 41.2 и в конце 41.4 R/V "Az. Station", beeping at the beginning of station 41.2 at end 41.4
	Канал во льду, проложенный судном Channel in the ice, made by the ship
	УЛТРАЗВУКОВЫЙ ТЕРМОМЕТР (РАДИО ДЕНКИ ФРГ) АУСТИКОВЫЙ ИЗМЕРИТЕЛЬ ВЫСОТЫ СКОРОСТИ ВЕТРА И ТЕМПЕРАТУРЫ (ФРГ)
	ARGOS BUOY (ФРГ) МЕСТО УСТАНОВКИ АРГОС-БУЙ (ФРГ)
	RADIATION MEASUREMENTS (FRG) МЕСТО ИЗМЕРЕНИЯ СЛИЗКОГО РАДИАЦИОННОГО БУЛЛЕСА (ФРГ)
	Thickness profile (USA) ПРОФИЛЬ КИШКИ АЛДНОГО И СНЕЖНОГО ПОКРОВА (США)
	Ice core site (USA) МЕСТО ОТБОРА ЯДРЕНА ДЛЯ ИССЛЕДОВАНИЯ СВОЙСТВ ЛДАА (США)

1	2	3
8		
		Место отбора кернов для исследования гравия ААА (USSR) Ice core site (USSR)
9		
		Optical site (USA) Место проведения оптических наблю- дений (США)
10		
		ГРАДИЕНТНАЯ СТАНЦИЯ (СССР) GRADIENT TOWER (USSR)
11		
		Изучение деформации ледяного покрова (СССР) Ice deformation measurements (USSR)
12		
		Измерения альбедо (СССР) Albedo measurements (USSR)
13		
		Место взятия проб ААА для исследова- ния стратификации в 11-16 октября ААА 13-16 октября (СССР) Investigation of 11 and 16 profiles in the ice 13-16 October (USSR)
14		
		Место взятия проб ААА для исследова- ния ступенчатого хода в 11-16 октября ААА 10-11 октября (СССР) Investigation of 11 and 16 profiles in the ice 10-11 October (USSR)
15		
		Место для определения таяния ледяного покрова с верхней поверхнос- ти (СССР) Ice melting investigation (USSR)

Date _____

Ice station Океанографическая станция № 14-15 дата: 19 сентября 1989

КООРДИНАТИ НАЧАЛА

КООРДИНАТИ КОНЦА

$\varphi = 61^{\circ} 20' 0''$ S

$$\varphi = 61^{\circ}, 9' \leq 5$$

Beginning location

Ending location

$\lambda = 52^{\circ} 51' 0''$ W

$\lambda \approx 52^{\circ}49.8 \text{ W}$

Beginning time spent making a $13^{\circ}30'$
LMT $14^{\circ}30''$

Время похода = 19^h 30^m Ending time
GMT 20^h 30^m

Ending time

Legend for ice station maps.

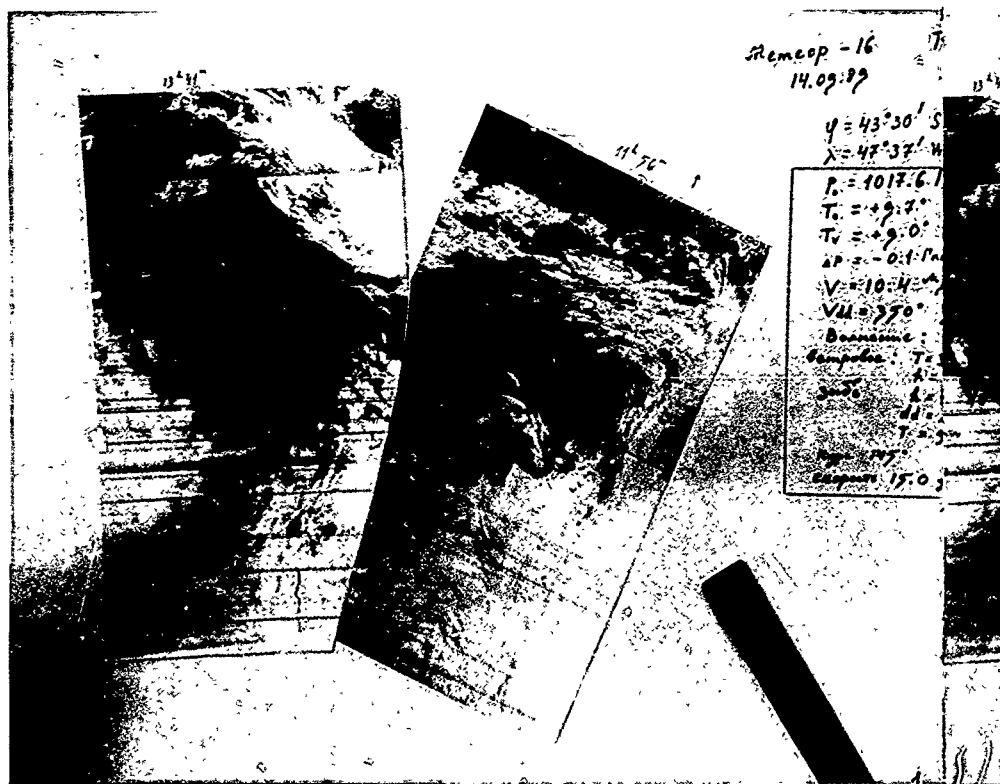


Figure 122. 14 September satellite photo, $43^{\circ}31'S$ $47^{\circ}37'W$.



Figure 123. 15 September satellite photo, 48° 30'S 42° 59'W.



Memcop-16 TV

16.09.89

$\varphi = 53^{\circ} 57' S$

$\lambda = 39^{\circ} 54' W$

$P_0 = 1015.4 \text{ PPa}$

$T_0 = 0.9^{\circ}$

$T_v = 0.8^{\circ}$

$\Delta P = -1.5 \text{ PPa}$

$V = 10.0 \text{ m/s}$

$V_{dd} = 281^{\circ}$

Боаннеме:

беттобоо:

$T = 5^{\circ} C$

$H = 1.5 \text{ m}$

Зноб:

$T = 11^{\circ} C$

$H = 3.0 \text{ m}$

$D = 220^{\circ}$

Кыгс 153°

Скорова 14 y3 ad

Тыма.

3.

Figure 124. 16 September satellite photo, $53^{\circ} 59' S$ $39^{\circ} 54' W$.



Figure 125. 17 September satellite photo, $57^{\circ}19'S$ $37^{\circ}24'W$.

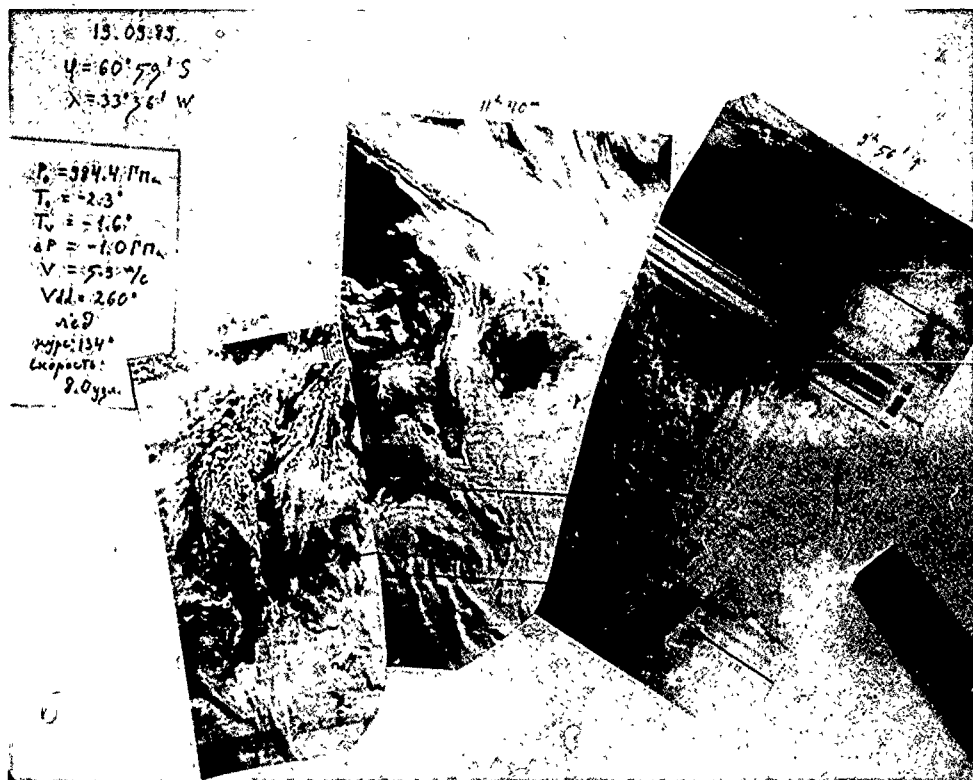


Figure 127. 19 September satellite photo, $60^{\circ} 59' S$ $33^{\circ} 36' W$.

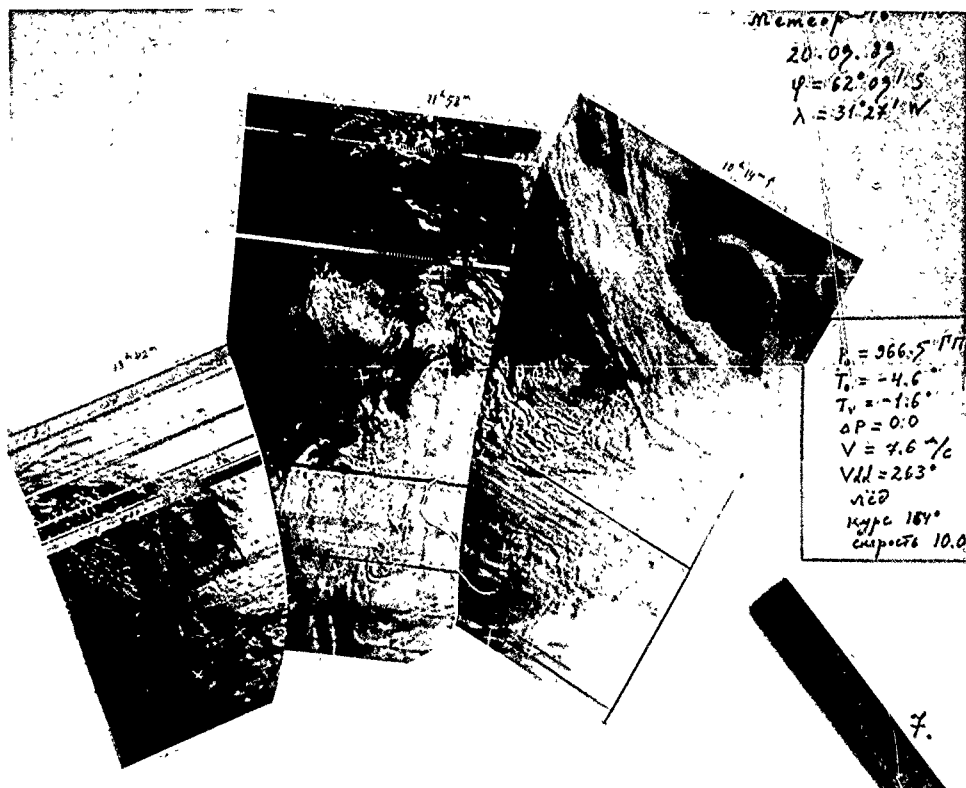


Figure 128. 20 September satellite photo, $62^{\circ}09'S$ $31^{\circ}27'W$.

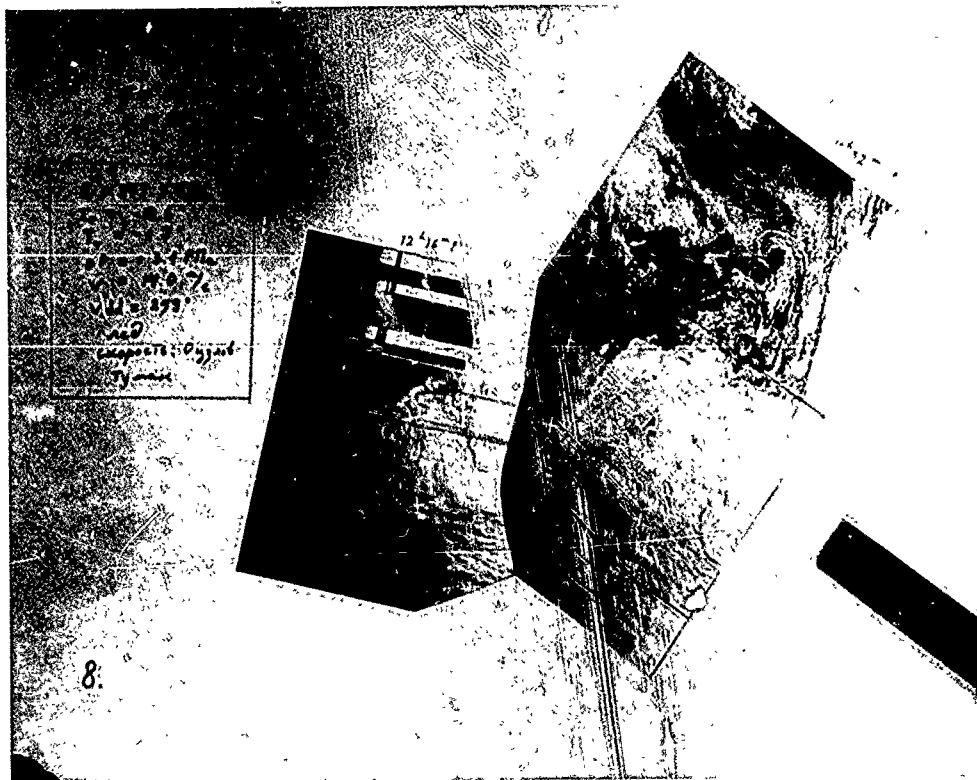


Figure 129. 21 September satellite photo, 63°36'S 28°40'W.



Figure 130. 22 September satellite photo, $65^{\circ}09'S$ $25^{\circ}51'W$.



Figure 131. 23 September satellite photo, $66^{\circ} 19' S$ $23^{\circ} 22' W$.

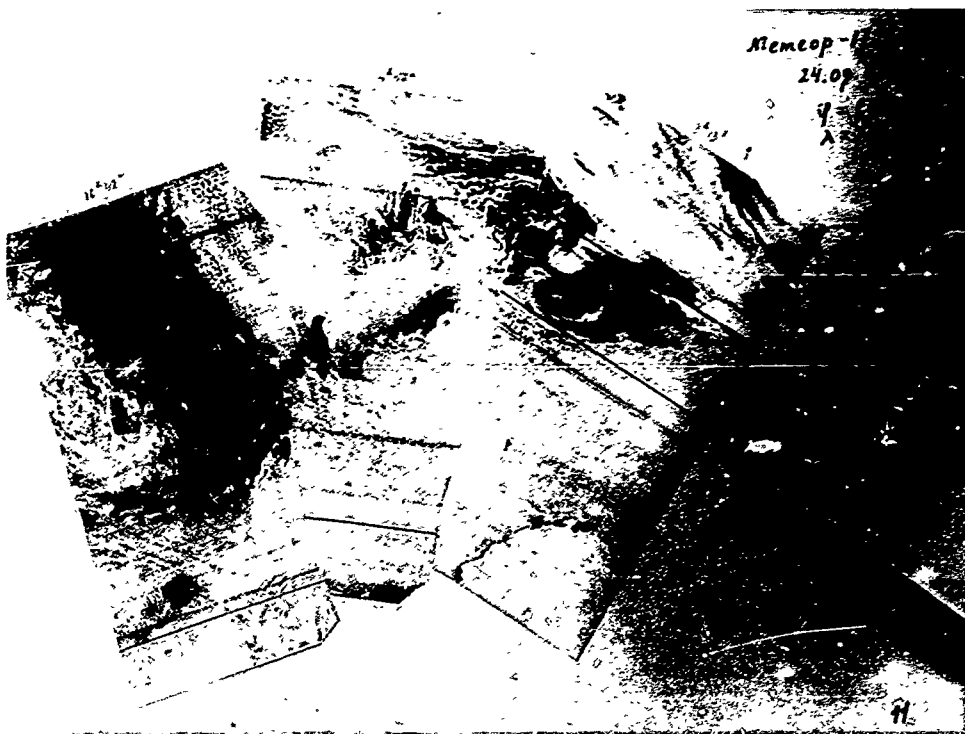
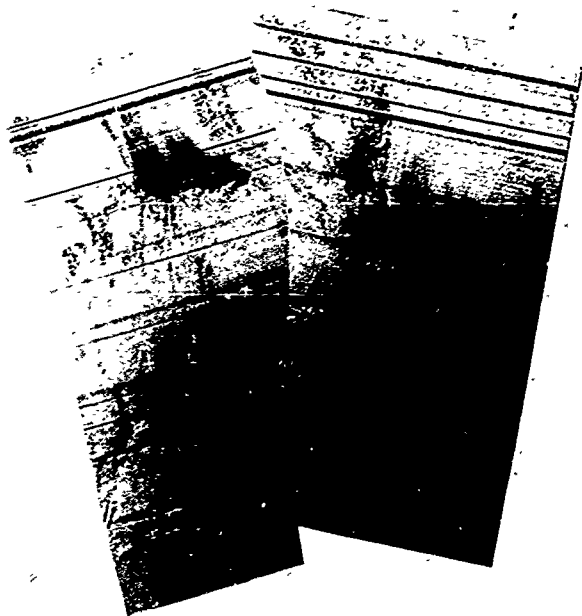


Figure 132. 24 September satellite photo, 67°22'S 21°19'W.



Figure 133. 25 September satellite photo, $67^{\circ}52'S$ $18^{\circ}47'W$.



26.09.89

$\varphi = 67^{\circ}34'S$

$\lambda = 16^{\circ}30'W$

$P_0 = 974.9 \text{ ГПа}$

$T_0 = -18.4^{\circ}$

$T_v = -1.8^{\circ}$

$V_v = 18:0 \text{ км/ч}$

$V_{ad} = 225^{\circ}$

лэд

скорость: 0 км/ч

СНЧЗ, мостов

13

Figure 134. 26 September satellite photo, $67^{\circ}34'S$ $16^{\circ}30'W$.

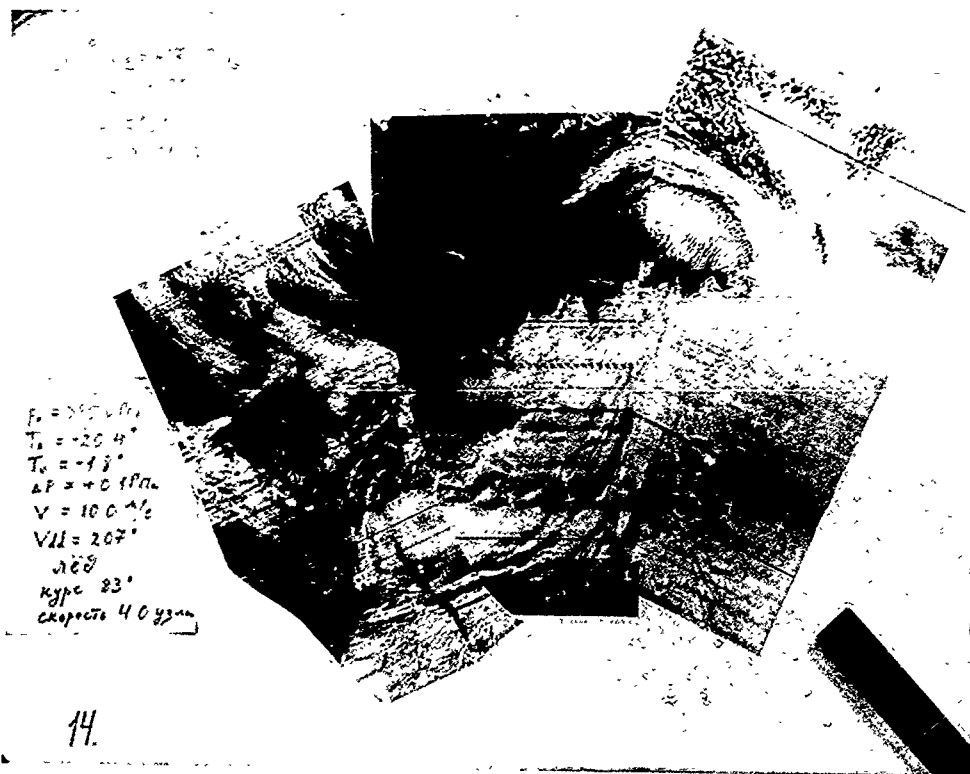
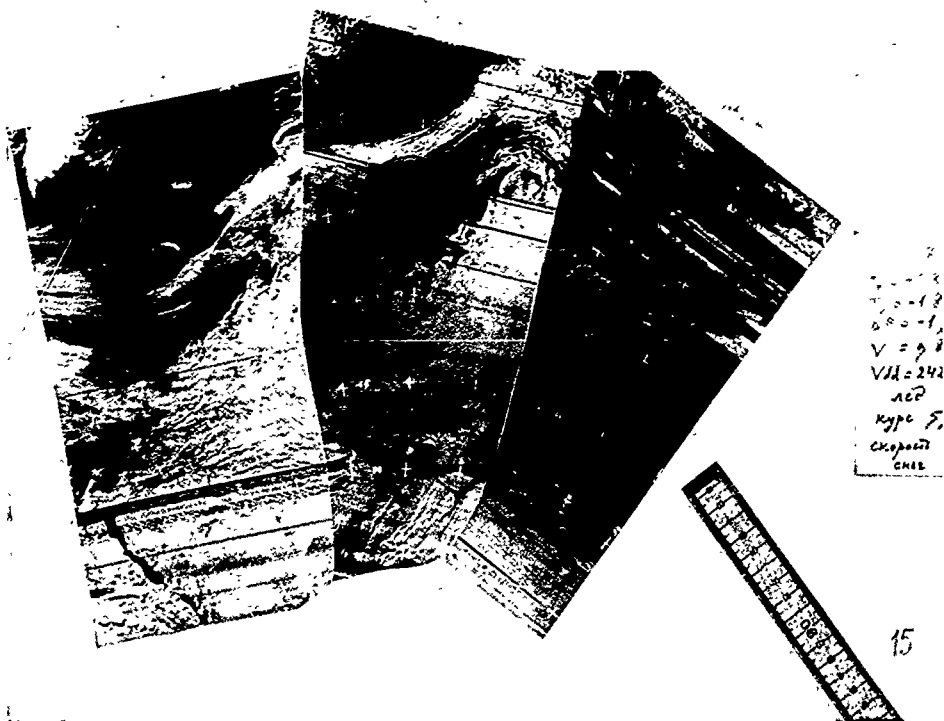


Figure 135. 27 September satellite photo, $67^\circ 30'S$ $13^\circ 51'W$.



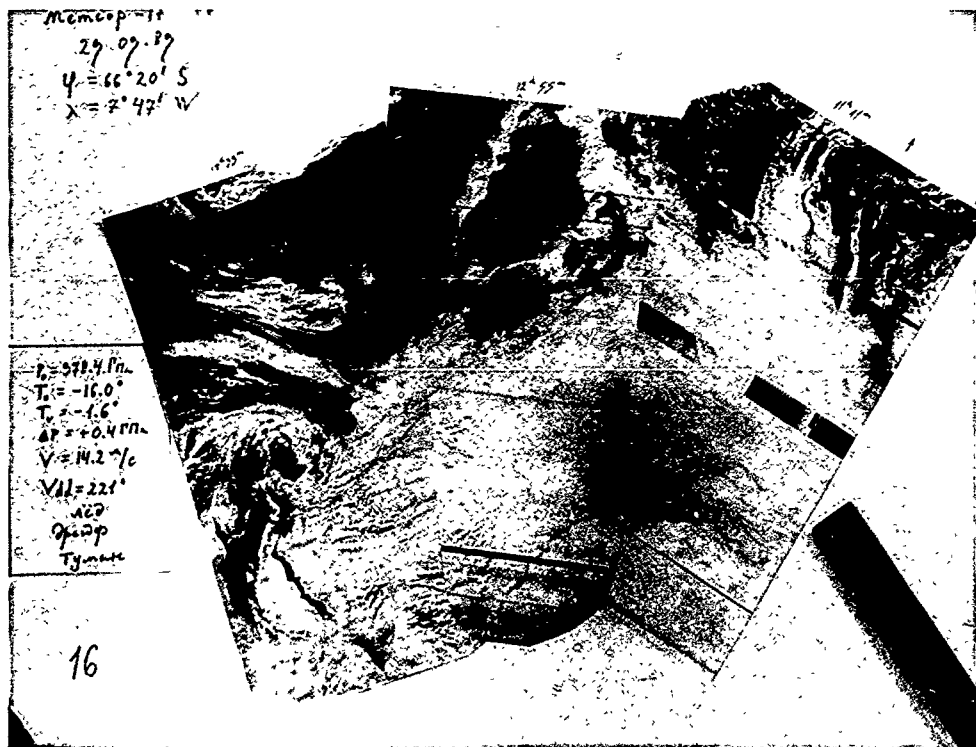


Figure 137. 29 September satellite photo, 66°20'S 7°47'W.

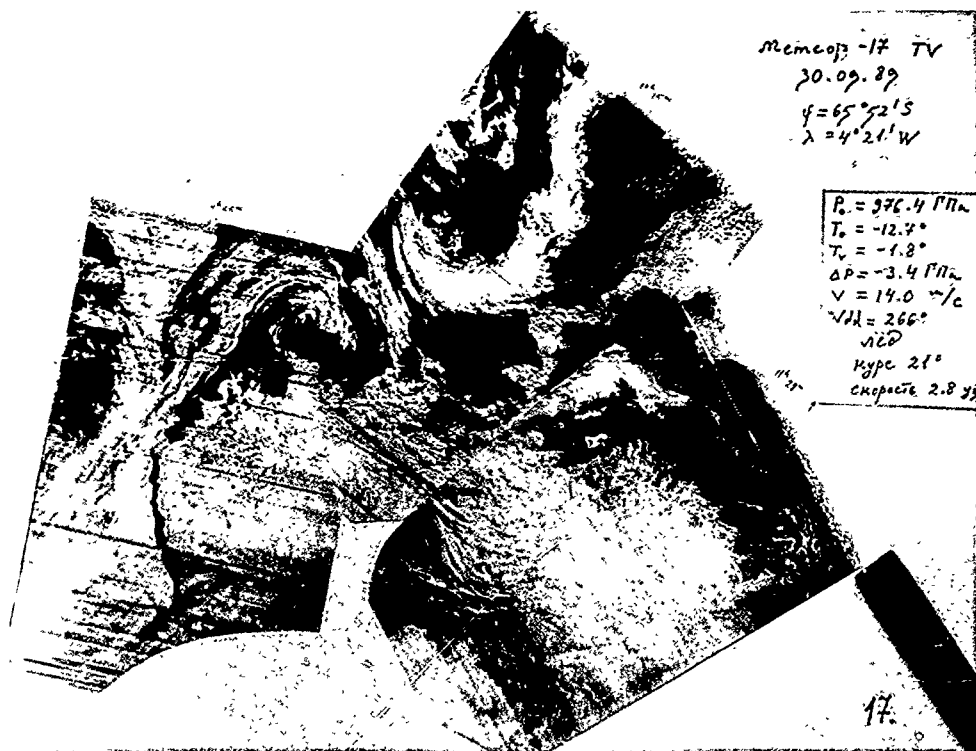


Figure 138. 30 September satellite photo, $65^{\circ} 52' S$ $4^{\circ} 21' W$.



Figure 139. 1 October satellite photo, 65°21'S 0°58'W.

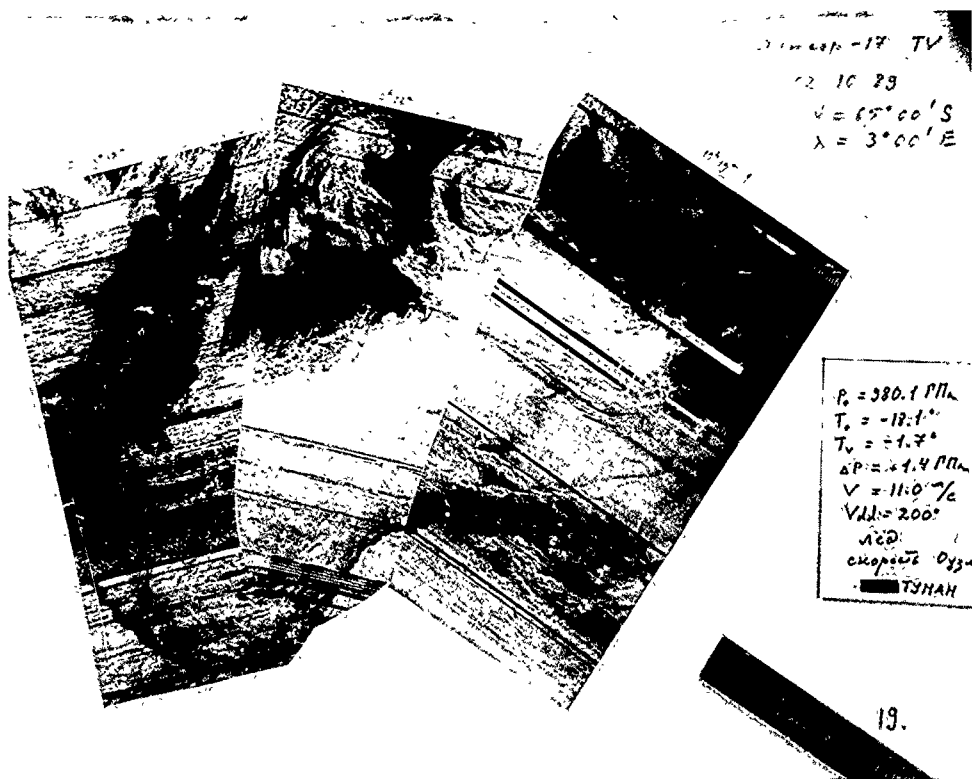


Figure 140. 2 October satellite photo, $65^{\circ}00'S$ $3^{\circ}00'E$.

Мемор-17 Т.

03.10.89

$\varphi = 66^{\circ}21'S$

$\lambda = 0^{\circ}25'W$

$P_0 = 932 \text{ ГПа}$

$T_0 = -16.5^{\circ}$

$T_v = -1.9^{\circ}$

$\Delta P = 0.0 \text{ ГПа}$

$V = 0.4 \text{ м/с}$

$V_{\text{дл}} = 241^{\circ}$

ЛСД

Скорость C_3

20.

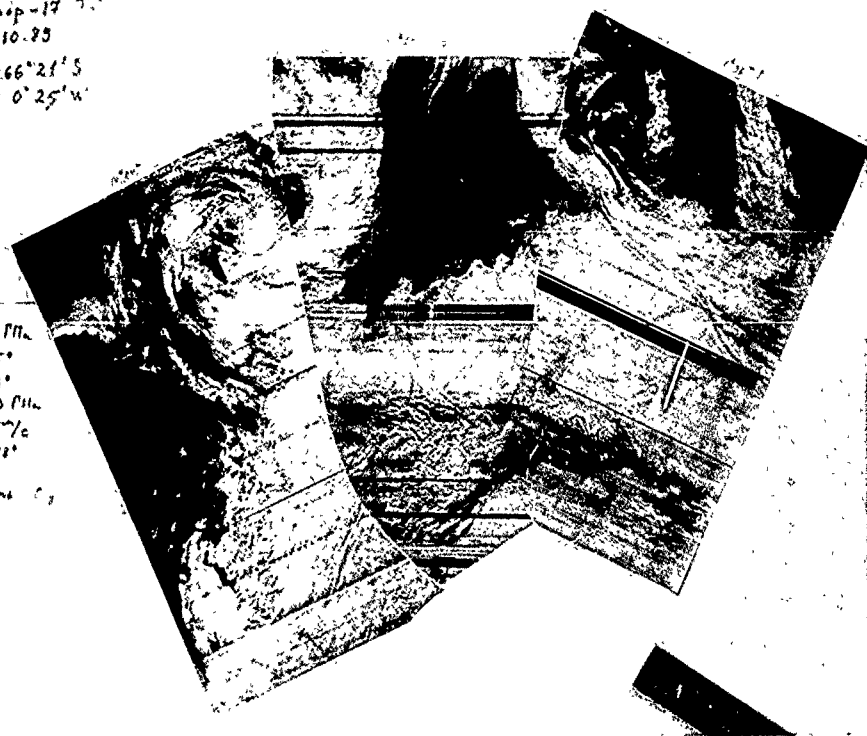
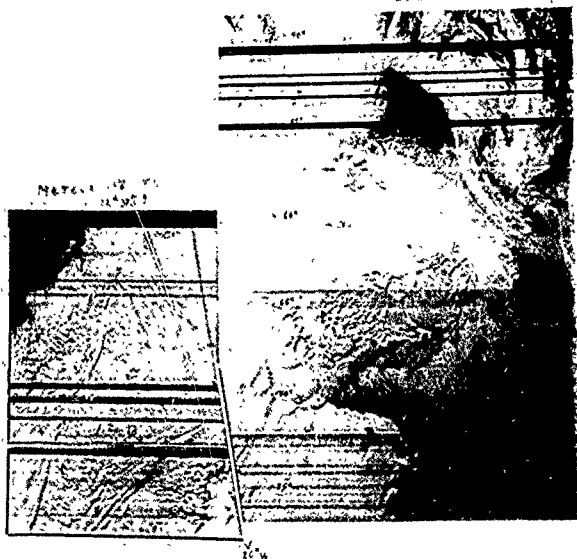


Figure 141.3 October satellite photo, $66^{\circ}21'S$ $0^{\circ}25'W$.

04 10 23

$\phi = 66^{\circ}07'S$

$\lambda = 2^{\circ}02'W$



$P_0 = 333.2 P_{H_0}$
 $T_0 = -7.3^{\circ}$
 $T_0 = -1.7^{\circ}$
 $\Delta T = +2.3 P_{H_0}$
 $V = 11.1 \text{ m/s}$
 $V_{11} = 22.2^{\circ}$
 $\Delta \theta$
 $\text{Kypc } 333^{\circ}$
 $\text{CKopocT } 2.4 \text{ y3a}$



21

Figure 142. 4 October satellite photo, $66^{\circ}07'S$ $2^{\circ}02'W$.

05. 10. 75

$\varphi = 64^{\circ}55'S$

$\lambda = 1^{\circ}58'W$

$P_0 = 555.3 \text{ ПП}$

$T_0 = -7.3^{\circ}$

$T_V = -1.8^{\circ}$

$\Delta P = +0.3 \text{ ПП}$

$V = 4.1 \text{ м/с}$

$V_{11} = 2.74^{\circ}$

дид

співр

сміс

22.

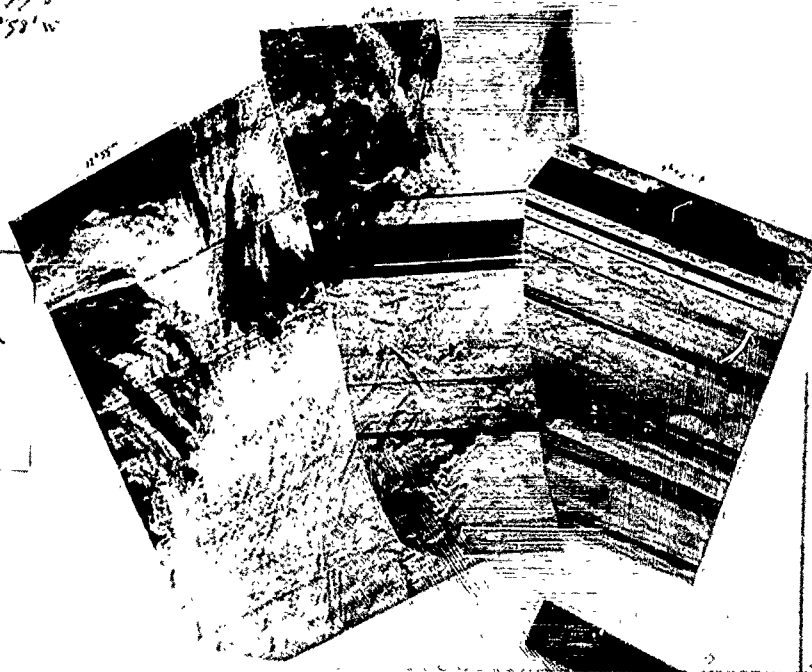


Figure 143. 5 October satellite photo, $64^{\circ}59'S$ $1^{\circ}58'W$.

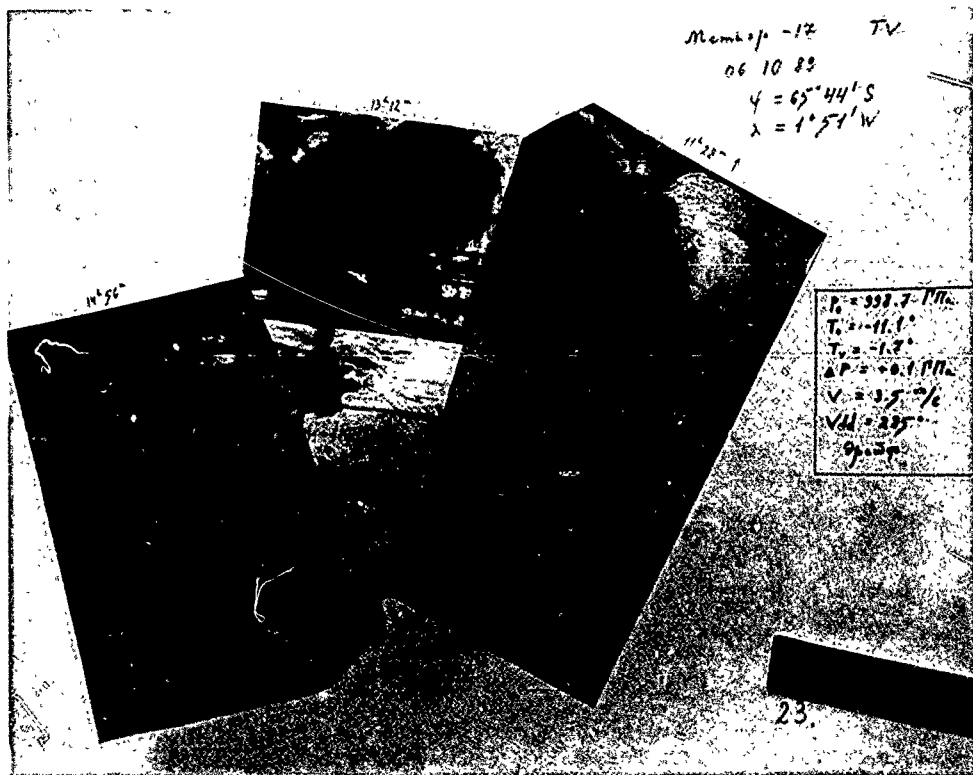


Figure 144. 6 October satellite photo, $65^{\circ}44'S$ $1^{\circ}51'W$.

Memor - 17 TV

07.10.85

$\lambda = 65^{\circ}52'S$

$\lambda = 1^{\circ}52'W$

$\lambda = 314.102$

$\lambda = 77^{\circ}$

$\lambda = 17^{\circ}$

$\lambda = 1.5 PM$

$\lambda = 13.2 \text{ m/s}$

$\lambda = 24^{\circ}$

Opisov

chiz

24.

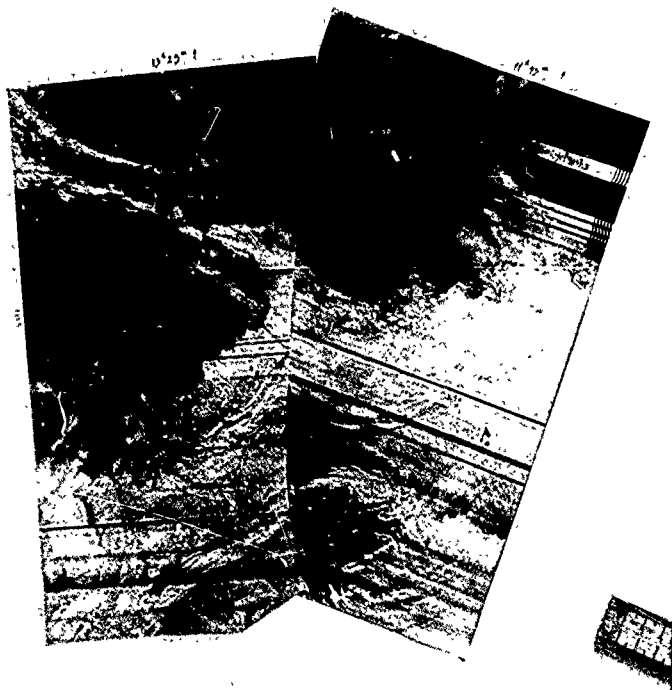


Figure 145. 7 October satellite photo, $65^{\circ}52'S$ $1^{\circ}52'W$.

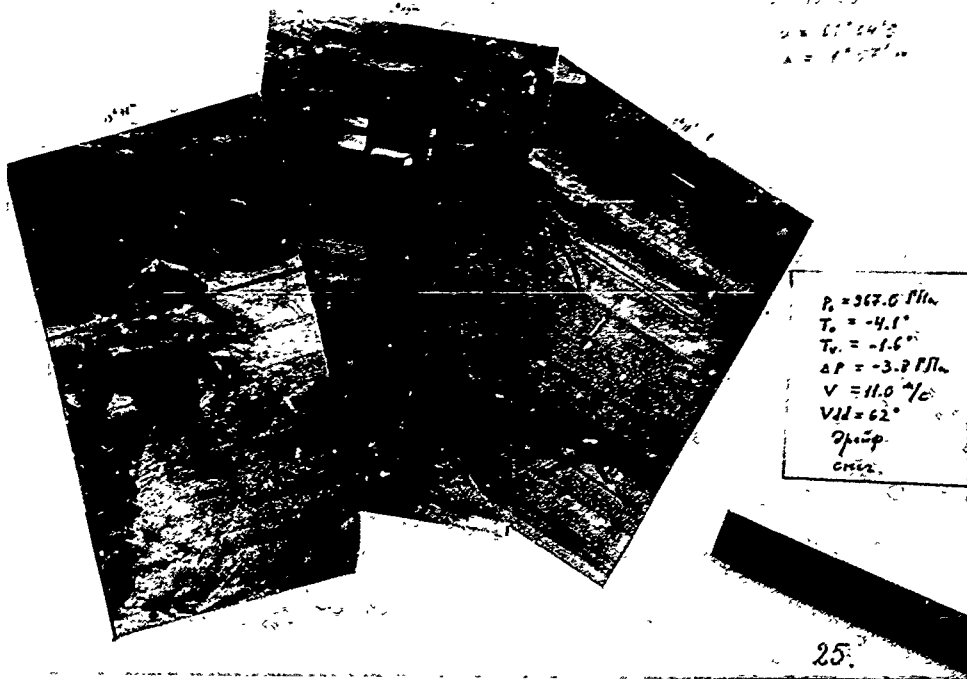


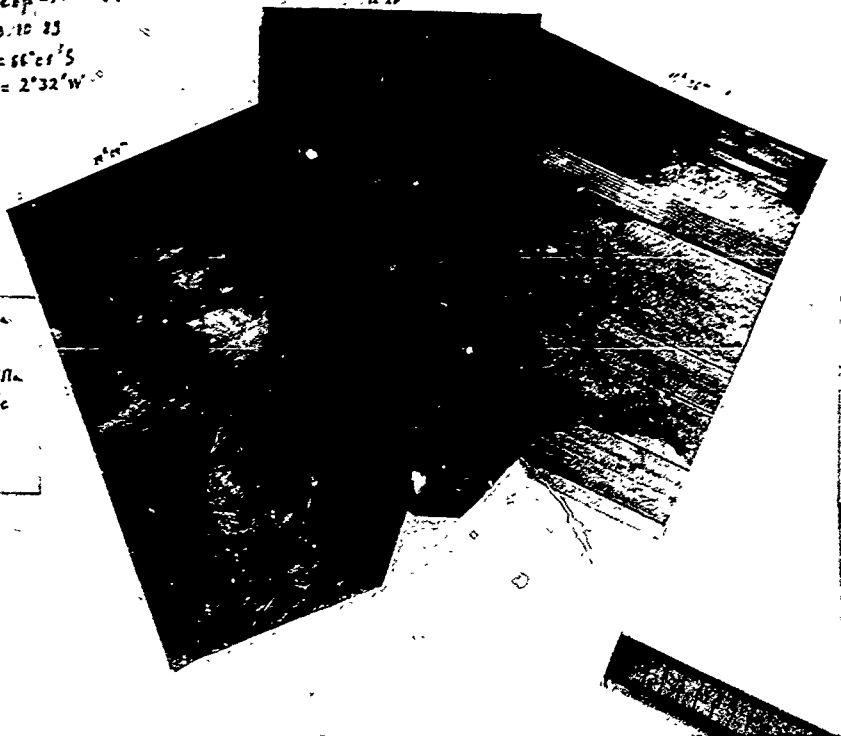
Figure 146. 8 October satellite photo, $66^\circ 04'S$ $1^\circ 57'W$.

Memo Sp-12 TV

03.10.83

$\varphi = 66^{\circ}01'S$

$\lambda = 2^{\circ}32'W$



$P_r = 313.6 \text{ fPa}$
 $T_r = -13.4^{\circ}$
 $T_v = -2.6^{\circ}$
 $\Delta P = -0.8 \text{ fPa}$
 $v = 12.2 \text{ m/s}$
 $V_{11} = 46^{\circ}$
 $\Delta \theta$
 $\theta_{\text{ref}} = 0$

26.

Figure 147.9 October satellite photo, $66^{\circ}01'S$ $2^{\circ}32'W$.

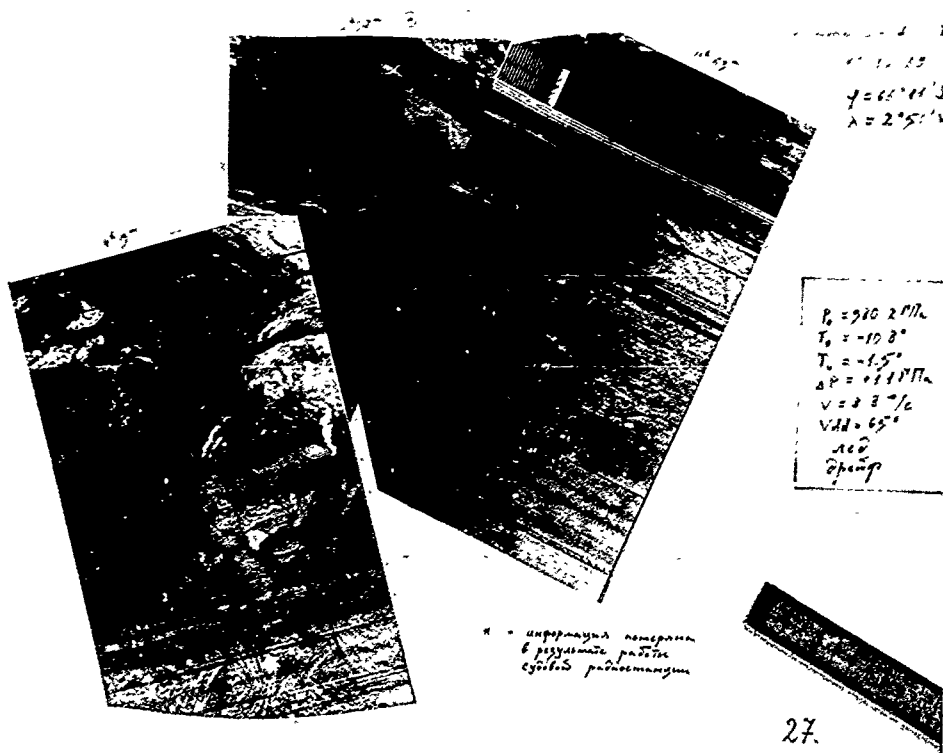


Figure 148. 10 October satellite photo, $66^{\circ} 11'S$ $2^{\circ} 50'W$.

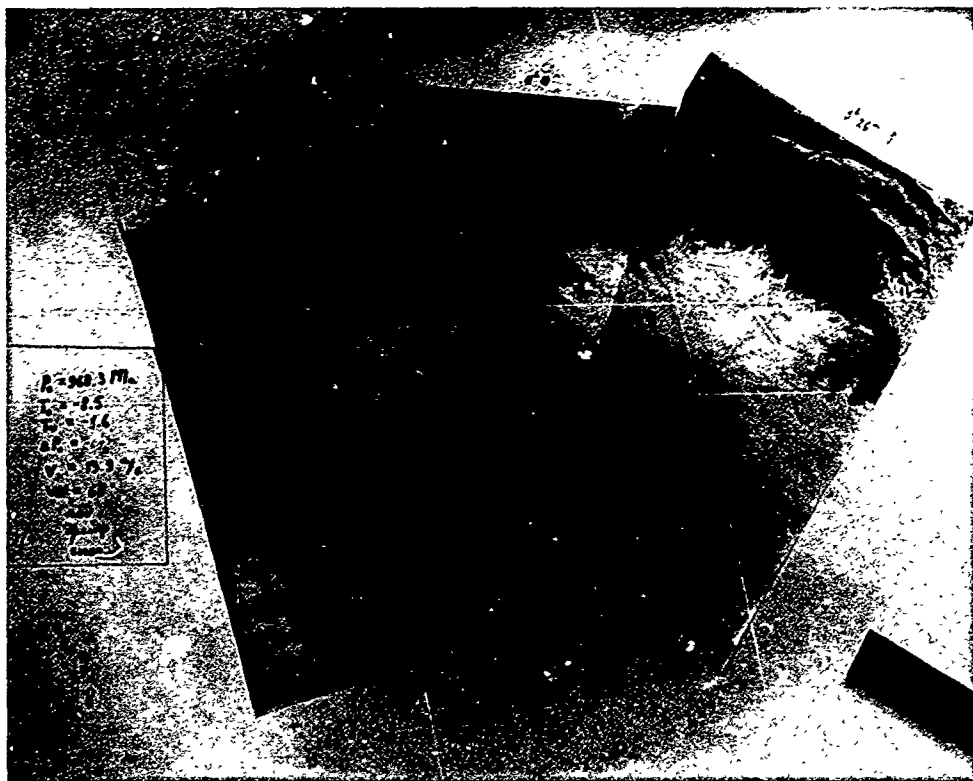


Figure 149. 11 October satellite photo, $66^{\circ}17'S$ $3^{\circ}05'W$.



Figure 150. 12 October satellite photo, $66^\circ 14'S$ $3^\circ 57'W$.

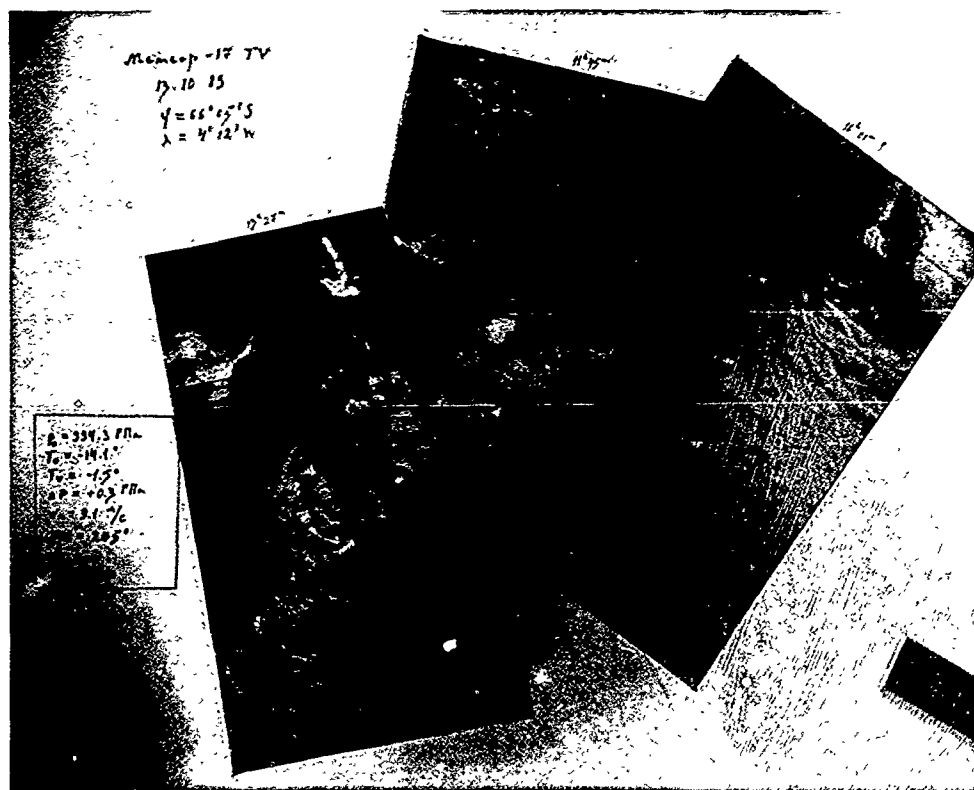


Figure 151. 13 October satellite photo, $66^{\circ} 05' S$ $4^{\circ} 12' W$.



Figure 152. 14 October satellite photo, $65^\circ 56'S$ $4^\circ 14'W$

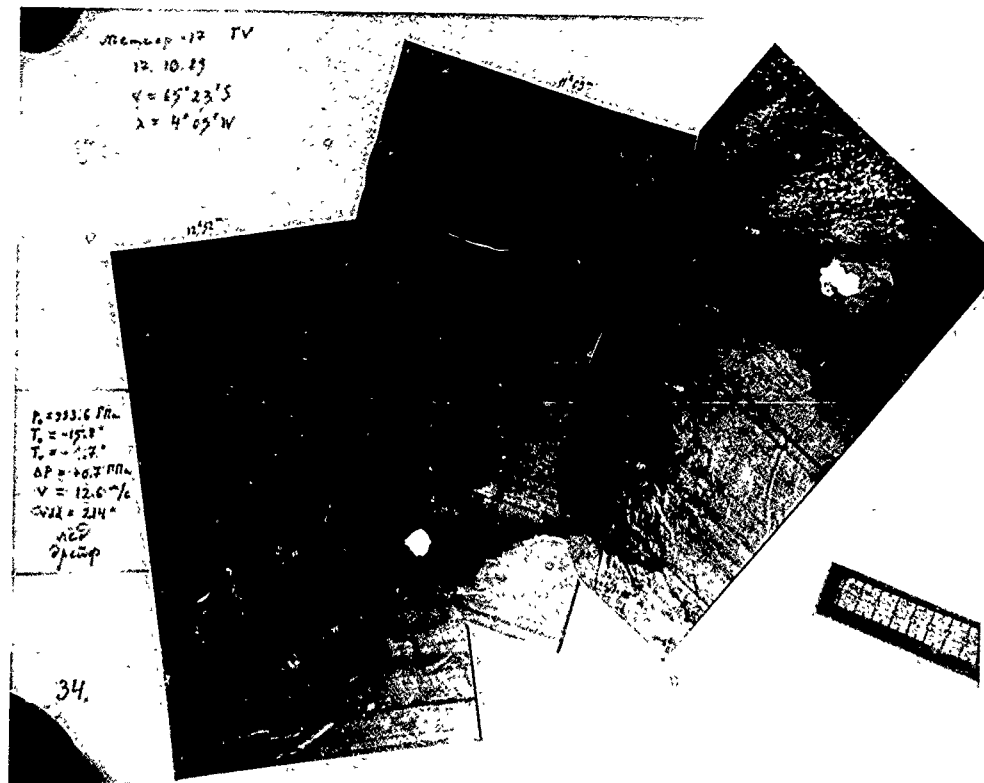


Figure 155. 17 October satellite photo, $65^{\circ}23'S$ $4^{\circ}09'W$.

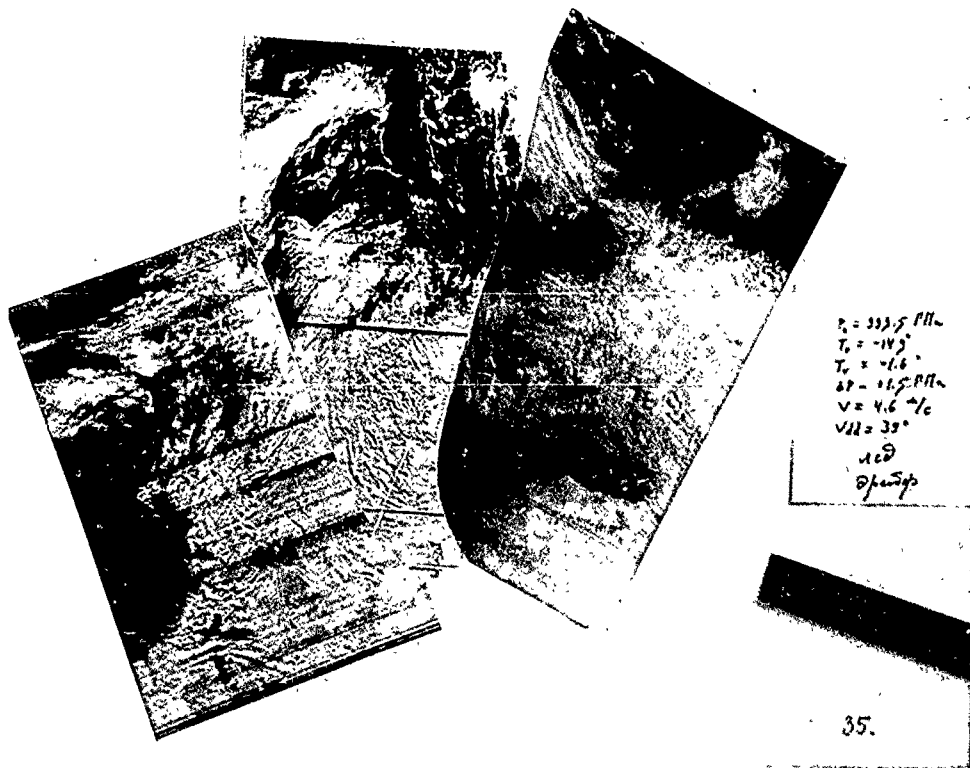


Figure 156. 18 October satellite photo, $65^\circ 22'S$ $4^\circ 07'W$.

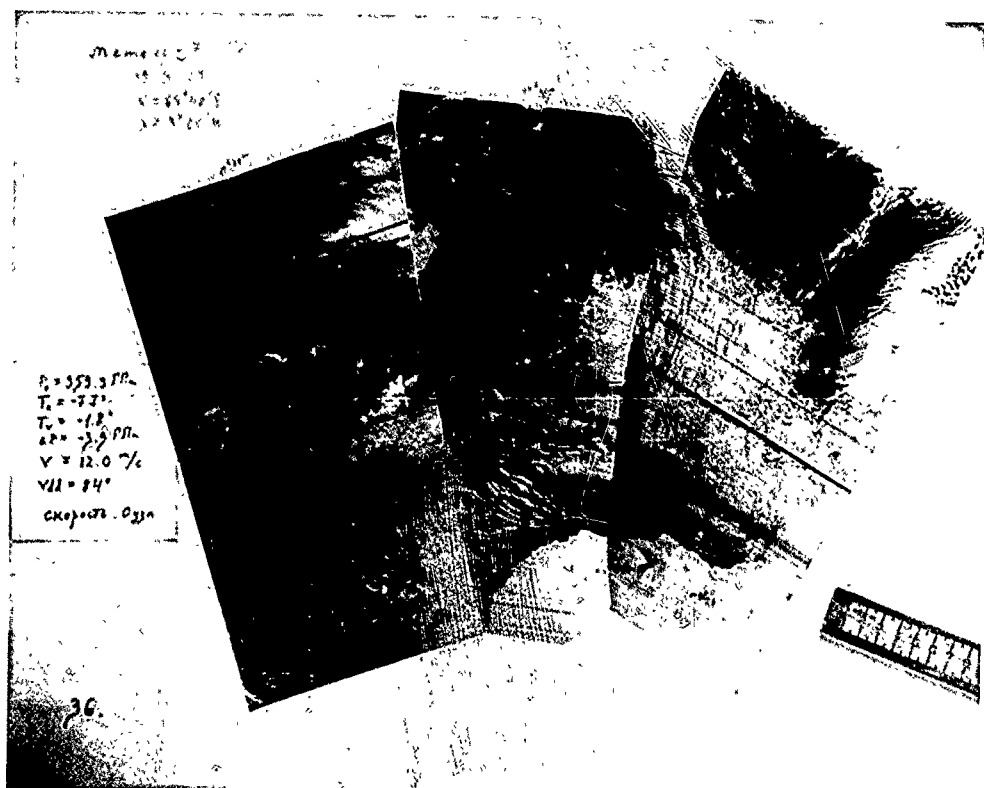


Figure 157. 19 October satellite photo, $64^\circ 48' S$ $3^\circ 00' W$.

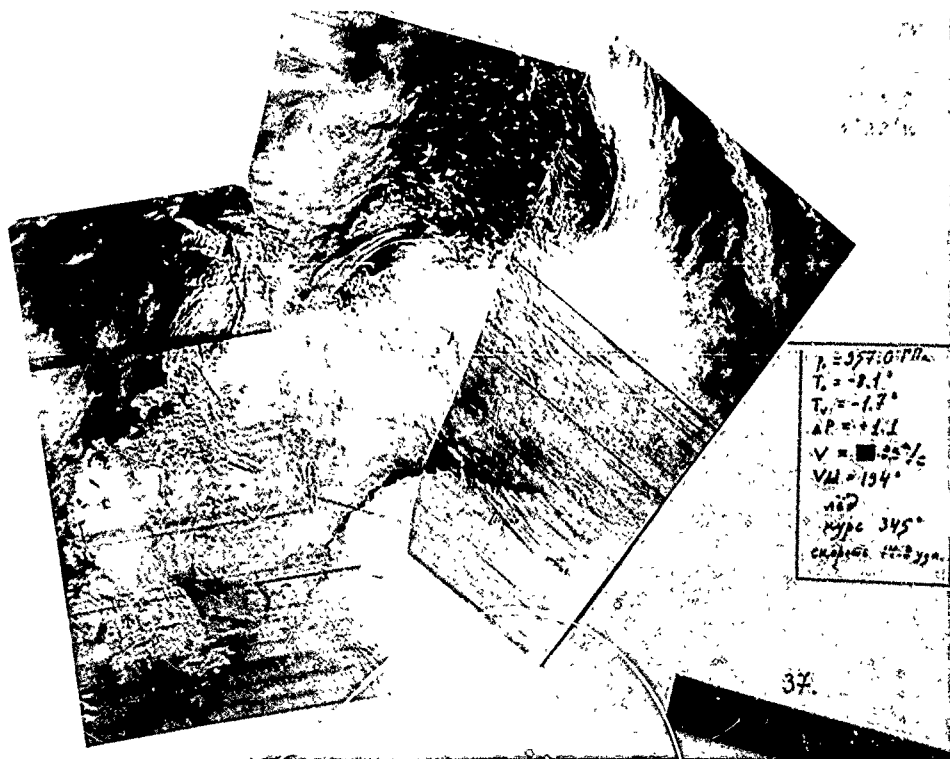


Figure 158. 20 October satellite photo, $63^\circ 49'S$ $5^\circ 28'W$.

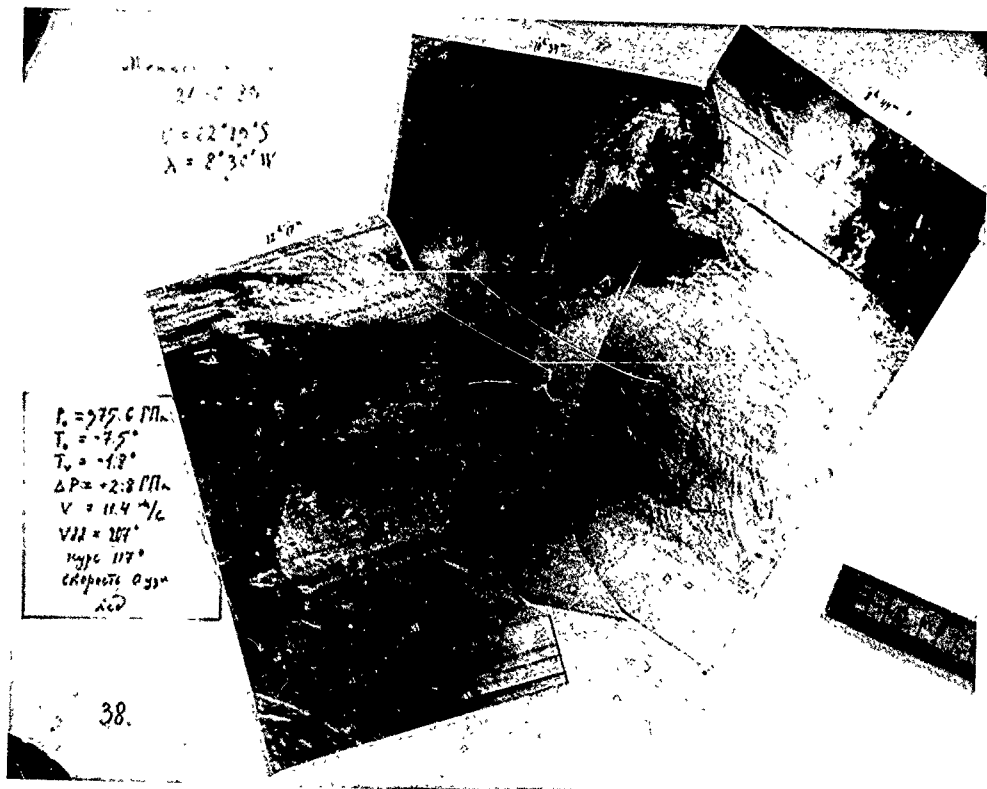


Figure 159. 21 October satellite photo, $62^{\circ}19'S$ $8^{\circ}30'W$.



Figure 160. 22 October: telerephot $52^\circ 16'S$ $134^\circ W$.

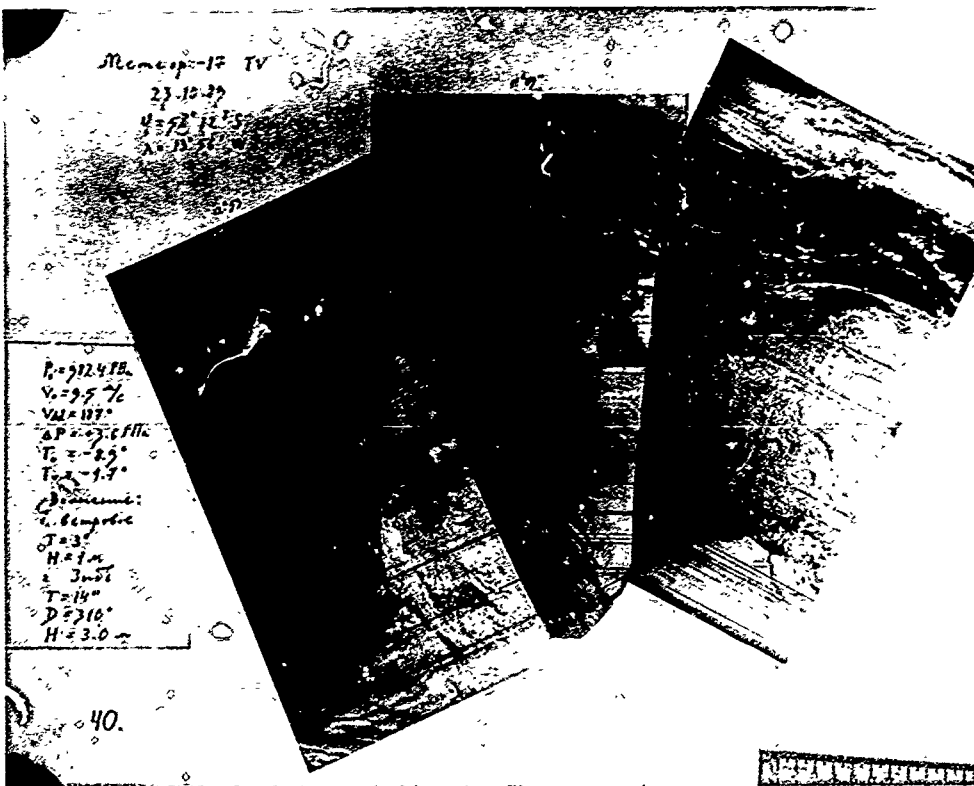


Figure 161. 23 October satellite photo, 58° 12'S 13° 56'W.

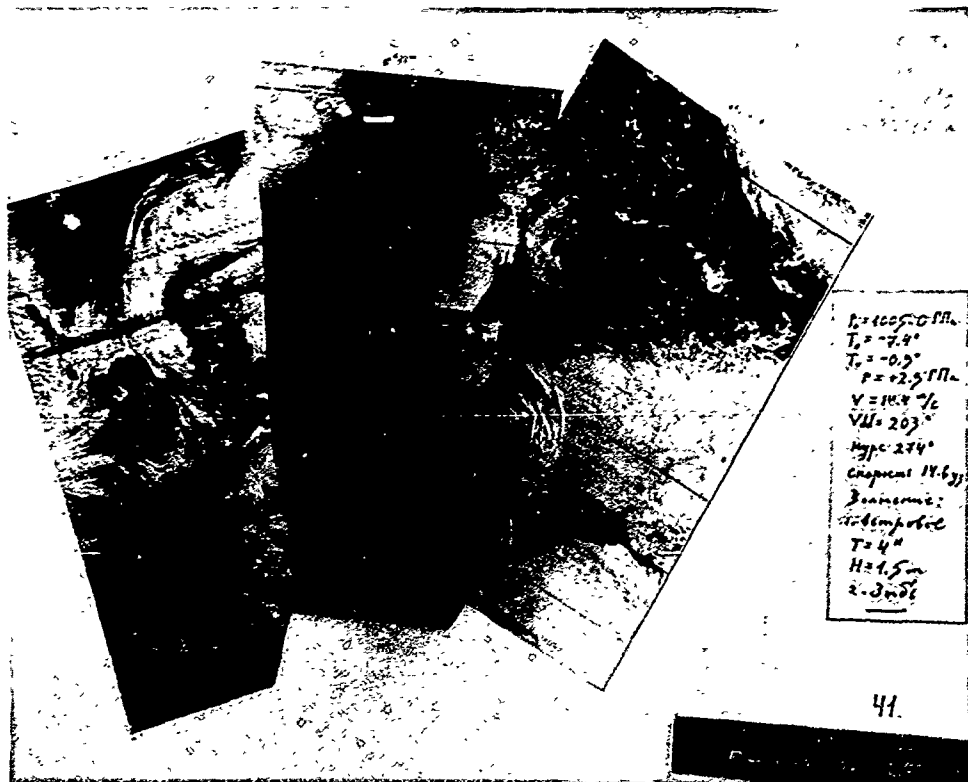


Figure 162. 24 October satellite photo, $58^\circ 06' \text{S}$ $22^\circ 36' \text{W}$.



Figure 163. 25 October satellite photo, $58^\circ 49' \text{S}$ $33^\circ 57' \text{W}$.

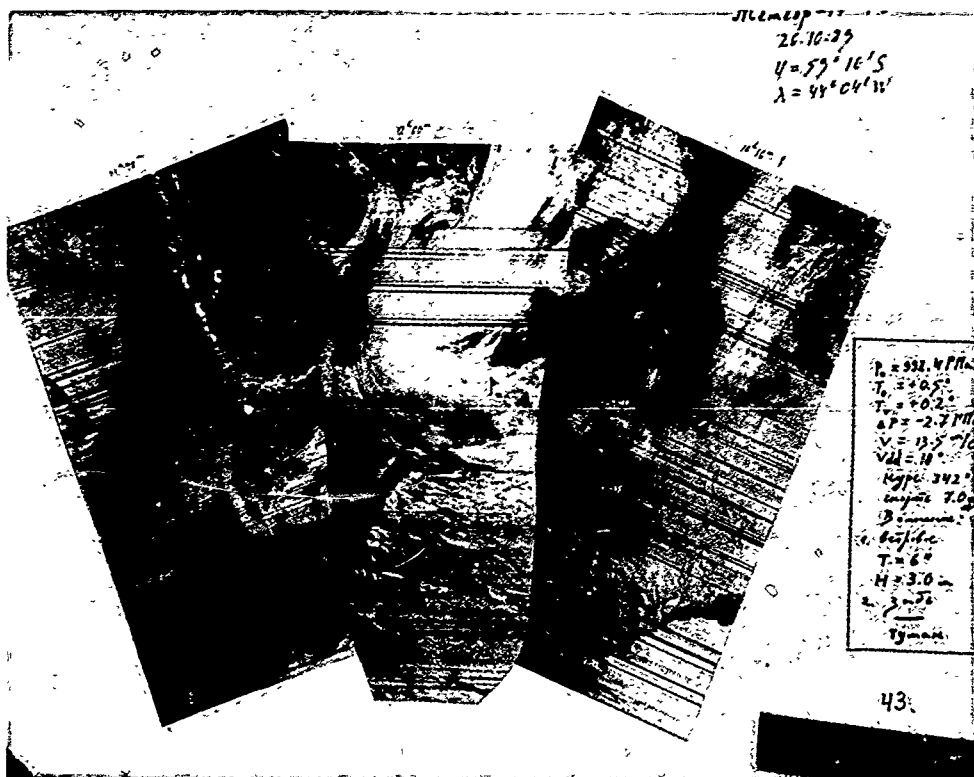


Figure 164. 26 October satellite photo, $59^{\circ} 16' S$ $44^{\circ} 04' W$.

$P = 952.4 \text{ ft}$
 $T_s = 9.4^\circ$
 $T_w = -0.3^\circ$
 $CP = +3.4 \text{ ft}$
 $V = 26.6 \text{ m/s}$
 $V_{DA} = 16.3^\circ$
 $K_{H2O} = 9.00^\circ$
 $\text{image size } 9.6 \text{ ysa}$
 $B = \text{unassumed}$
 $1. \text{ Body size}$
 $T = 9'$
 $4 = 7.5'$
 $2. \text{ Body size}$
 $D = 140'$
 $T = 14''$
 $H = 8.5'$

44.

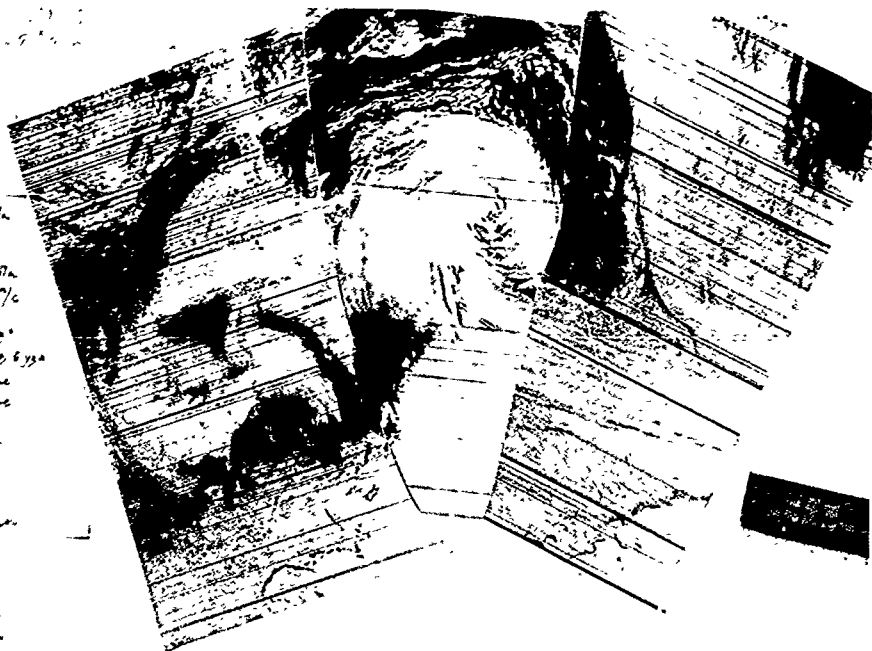


Figure 165. 27 October satellite photo, $60^\circ 23'S$ $54^\circ 15'W$

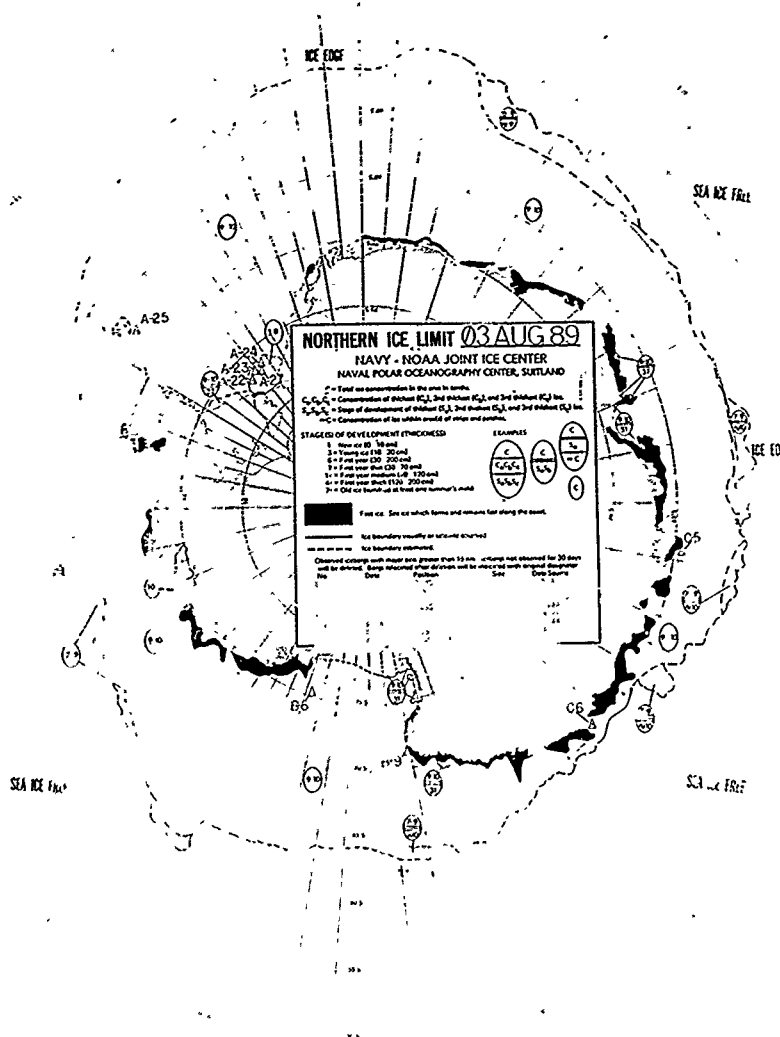
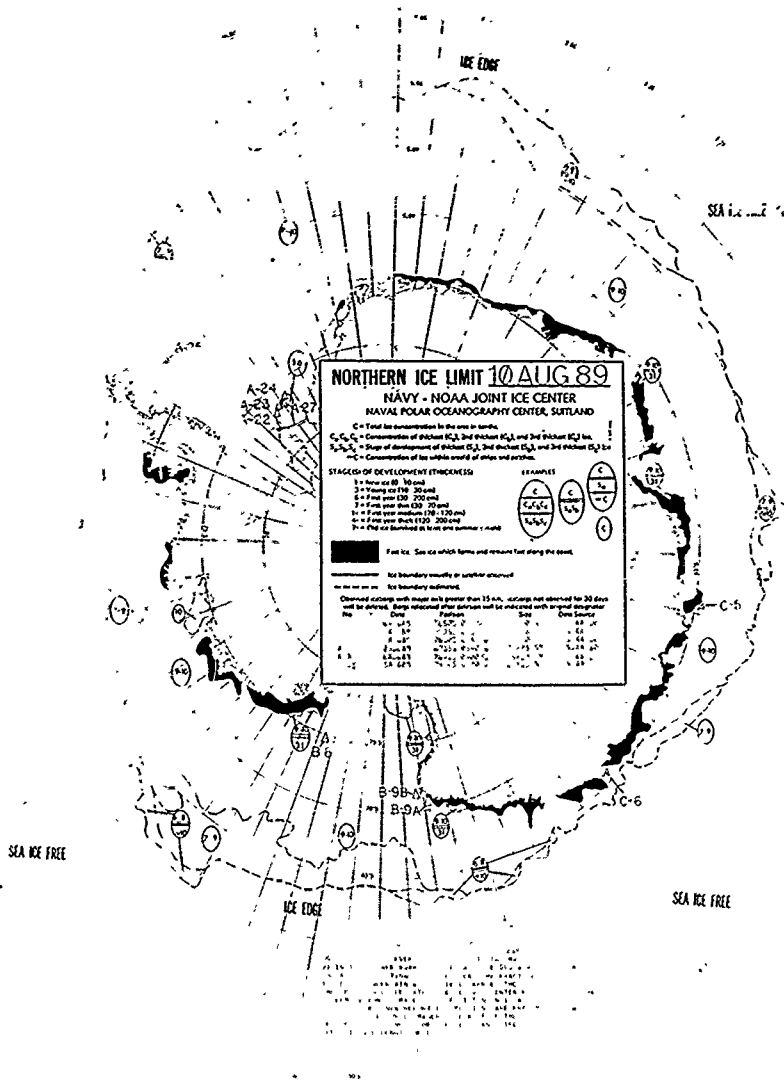


Figure 166.3 to 9 August 1989 ice extent.



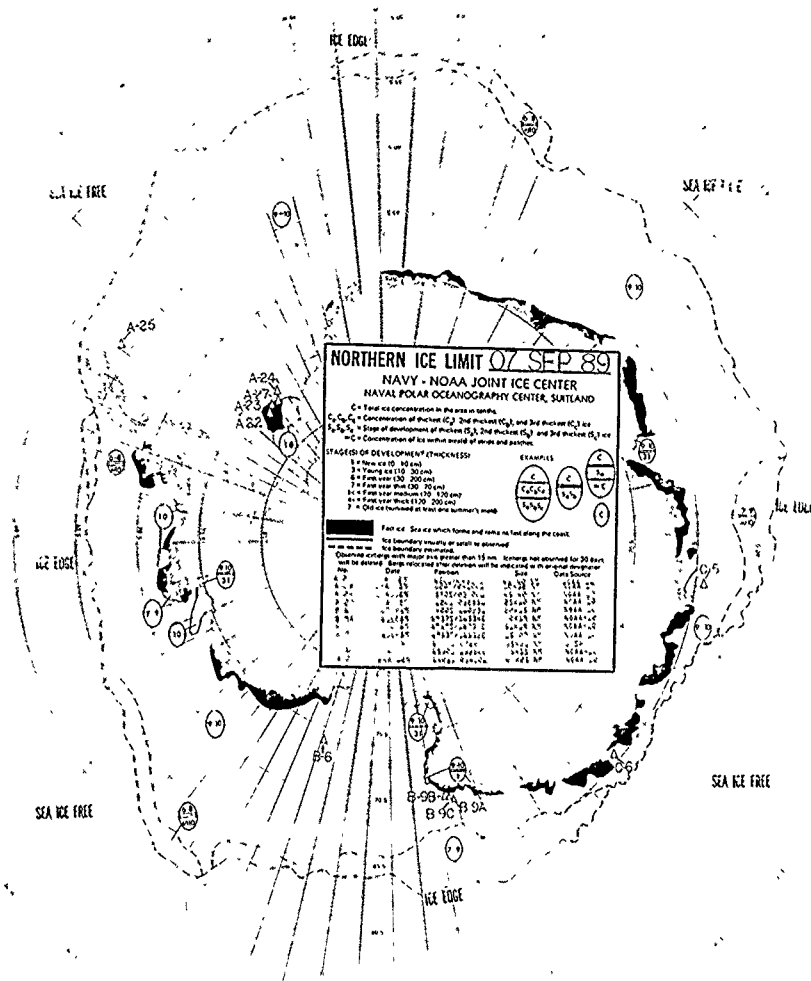


Figure 170. 7 to 13 September 1989 ice extent

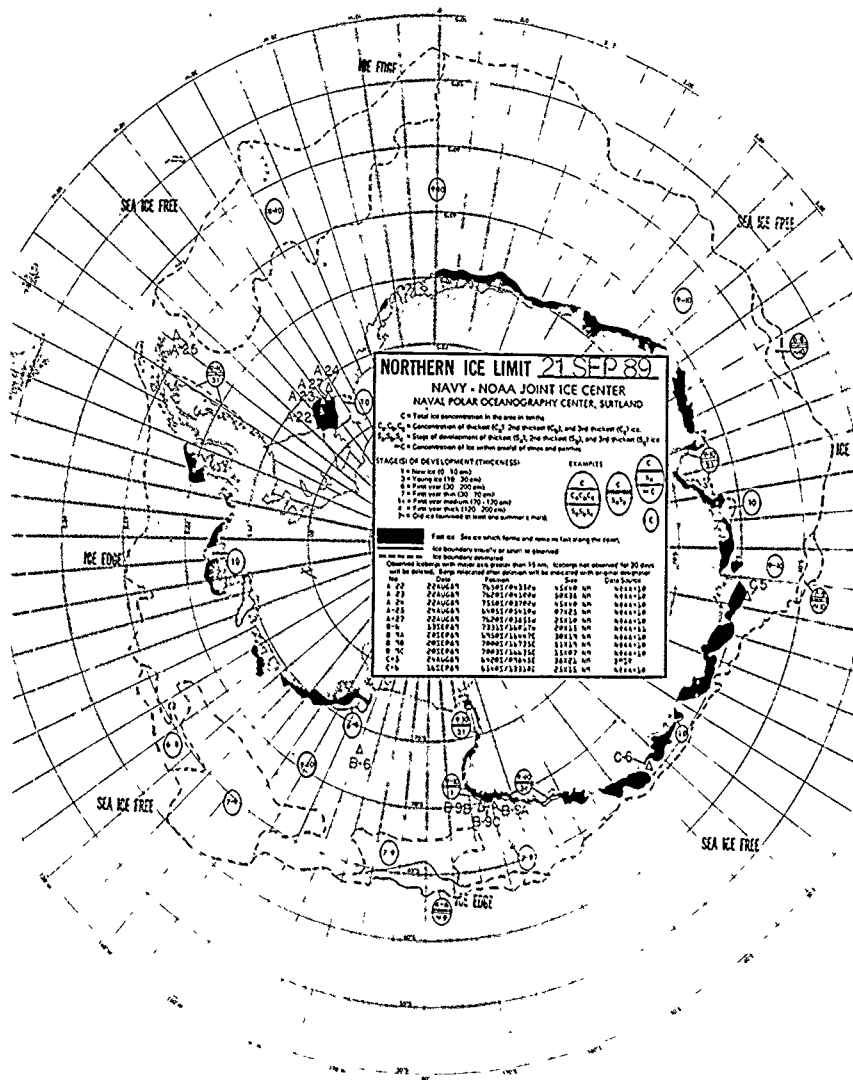


Figure 172. 21 to 27 September 1989 ice extent.

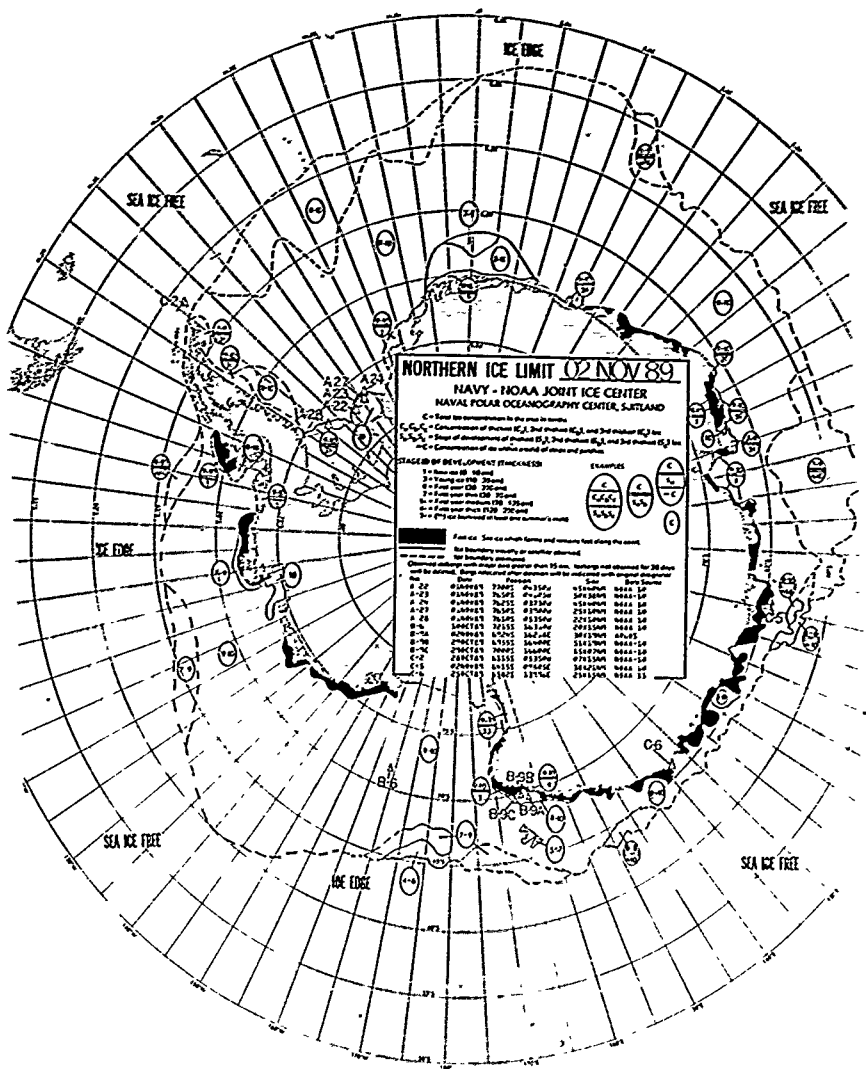


Figure 177.2 to 8 November 1989 ice extent.

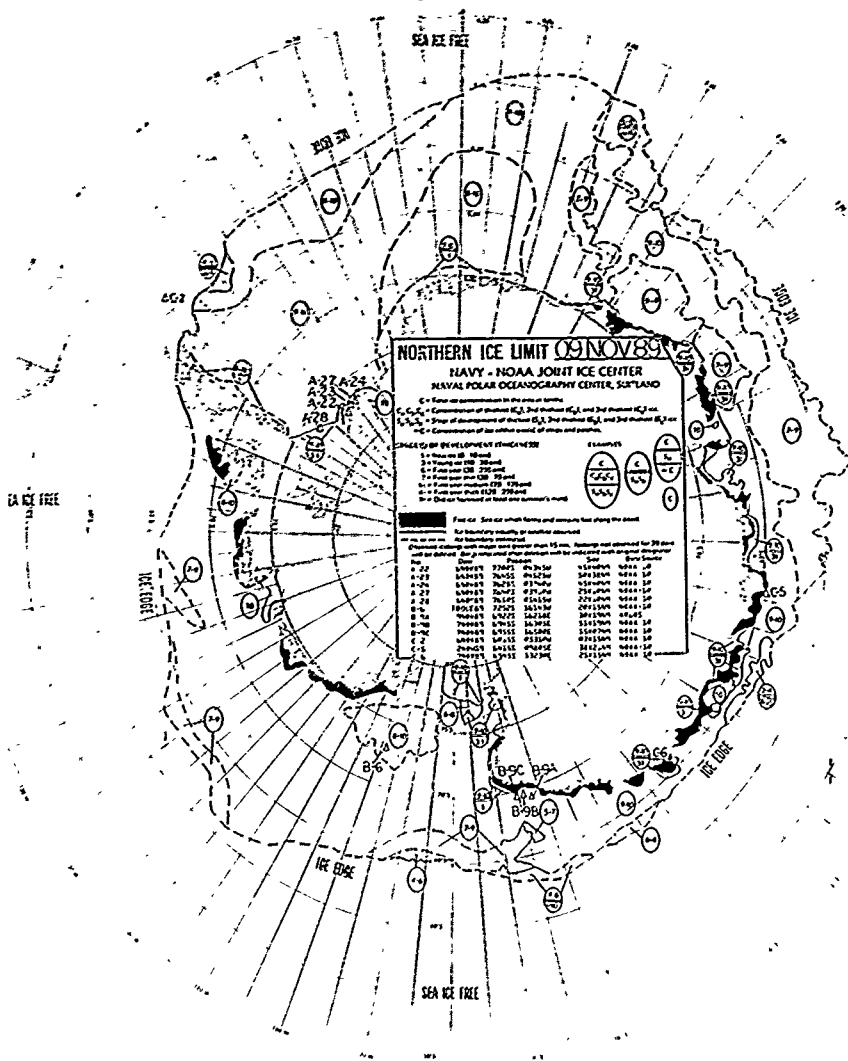


Figure 178. 9 to 15 November 1989 ice extent.

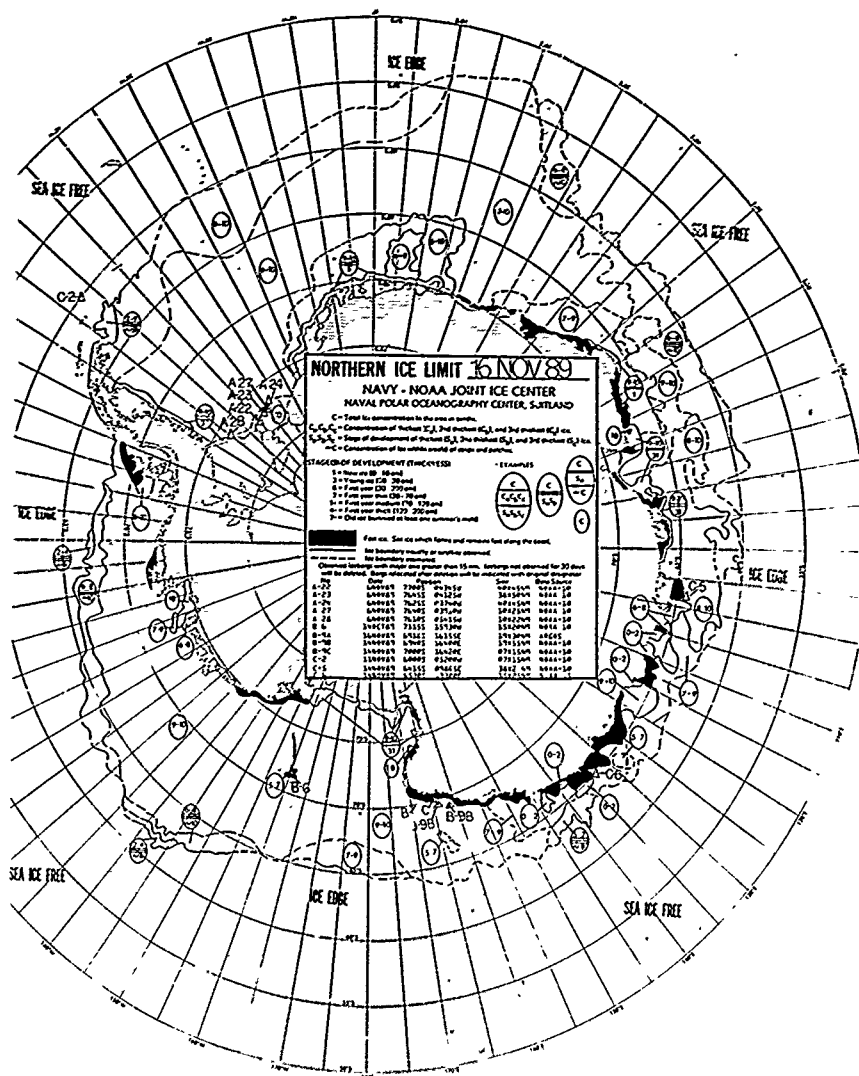


Figure 179. 16 to 22 November 1989 ice extent.

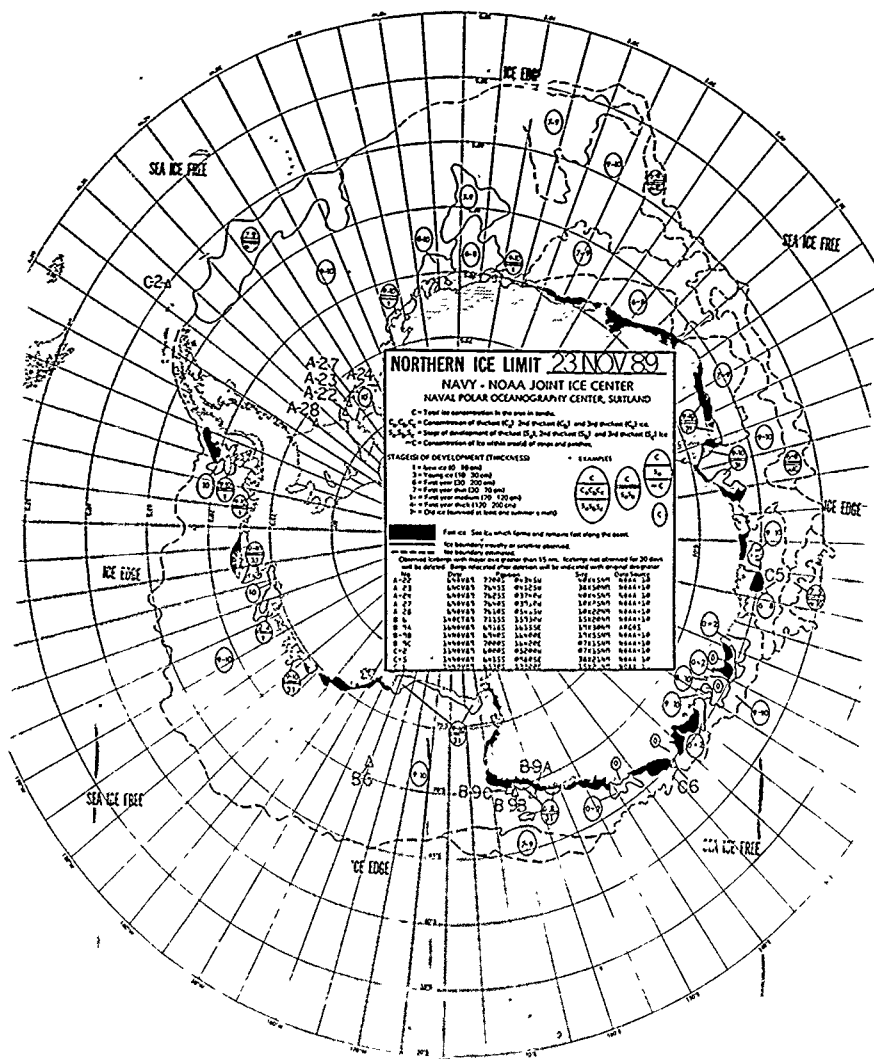


Figure 180. 23 to 29 November 1989 ice extent.

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