

14. SEA ICE OBSERVATIONS LOG¹

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INTRODUCTION

This is a log of all the sea ice observations made from the ice breaker *Fennica*, operating in support of the *JOIDES Resolution* (SEDCO/BP 471), in Fram Strait during the Ocean Drilling Program (ODP) Leg 151. The conventions used are those established for use during the Greenland Sea Project (Garrity and Ramseier, 1992), based on the World Meteorological Organization Standards (WMO, 1970).

The observations are based on all available sources of information: visual, radar, video, photographic, ship's log, and personal notes. They are necessarily subjective; examination of the video/photographic record will provide one way of standardizing the observations.

The log is organized in time and date sequence, with observations recorded at hourly intervals while the ship was in or close to ice cover. Additional notes were added on areas of particular interest, such as changes of ice type and floe size where these constituted a significant change from previously noted conditions.

FORMAT

Each day's observations are headed by the date; codes in square brackets (e.g., [A1, B4]) refer the reader to relevant satellite images (Appendix A), ship's charts (Appendix B), and photographs (Appendix C). Each entry gives the time of observation, the latitude (Lat.) and longitude (Long.) at which it was made, and the conditions prevailing at the time: wind speed (Spd.) and direction (Dir.), atmospheric pressure (Press.), air temperature (Air), and water temperature (Wtr.). A question mark (?) indicates questionable or missing information.

CONVENTIONS

The following conventions are used in the text:

Latitude: degrees and decimal minutes
Longitude: degrees and decimal minutes
Time: all times given are UTC
Date: all dates are given as dd/mm/yy
Temperature: degrees Centigrade (to nearest degree)
Pressure: millibars
Wind speed: meters per second (to nearest meter)
Direction: degrees (true)
Approx: is used for "approximately"

When referring to floe sizes the following abbreviations may be used: F1 = 1–2 m; F2 = 2–20 m; F3 = 20–100 m; F4 = 100–500 m.

Copies of the ship's charts use the Swedish/Finnish ice charting symbols (Svensk Sjöfartsverket, 1992).

SATELLITE IMAGERY

SAR and SSMI

Interpreted Synthetic Aperture Radar (SAR) images, from the ERS-1 satellite, and Special Sensor Microwave Imager (SSMI) images, from DMSP satellites, were made available to the *Fennica* and the *JOIDES Resolution* by the Nansen Environmental and Remote Sensing Center (NERSC) under contract to ODP. The images were obtained by the ships either by facsimile or by computer download via satellite link to NERSC in Bergen. All the SAR and SSMI images used as figures in this log were obtained in the latter manner.

METEOR and NOAA

Fennica was able to pick up NOAA and Russian METEOR satellite, visible and infrared band, imagery directly. The almost constant total cloud cover during drilling operations meant the imagery could not be used for estimating the position of the ice. An example of a clearer METEOR image is shown in Appendix A, Figure 26.

ACKNOWLEDGMENTS

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SEA ICE OBSERVATIONS LOG

Time	Lat.	Long.	Spd.	Dir.	Press.	Air	Wtr.	Comments
16/08/93 [A01-A05]								
1905	79°19.1N	02°51.5E	-	-	1015	4	1	Ice edge visible on radar.
2000	79°21.0N	02°53.5E	-	-	1014	4	0	
2028	79°23.6N	02°54.4E	-	-	-	-	-	Ice streamer crossed, approx 1 nm wide, only tiny pieces of ice. Approx 0.3 nm to ice edge (from radar).
2031								Further ice streamer. Pieces approx 0.2 m. Very scattered. Ice edge runs from East to West (from radar).
2036	79°24.0N	02°54.8E	-	-	-	-	-	Compact ice edge. Remains of first-year floes, 1-2 m thick, 4-5 m diameter.
2045	79°24.0N	02°57.0E	-	-	-	-	-	Running East along the ice edge. Some streamers of fine brash ice. Sky clearing.
2100	79°24.5N	03°04.2E	5	075	-	5	0	
2200	79°27.7N	03°39.1E	-	-	-	4	0	
2300	79°30.8N	04°21.4E	-	-	-	6	0	Following ice edge. Composition as reported above.
17/08/93								
1625	80°51.9N	10°38.7E	-	-	-	5	2	Ice edge sighted on radar, running Northeast. Small iceberg/growler sighted in edge.
1700	80°51.0N	10°47.1E	1	110	1014	5	1	Compact ice edge visible on radar.
1710	80°54.7N	01°51.0E	-	-	-	5	0	Ice streamers crossed, tiny fragments. Visibility very poor (less than 100 m). Ice edge runs to the North. Moving North following the edge.
1805	80°58.8N	10°55.1E	4	110	-	5	0	Visibility very poor (less than 100 m). Ship enters very well defined ice edge. Approx. 100 m of very small pieces, then into 95% cover. Floes about 10 m diameter. First-year ice, no evidence of ridging. Some melt pools on larger floes. Larger floes covered with small pieces of rubble. Freeboard of floes about 0.1 m, 1-2 m thick. Estimate floe sizes as 20% >10 m, 50% 5-10 m, 25% <5 m, 5% open water. No snow cover.
1840	80°57.2N	10°52.7E	-	-	-	5	-1	Ice edge exited. Composition as above.
2050	80°56.8N	10°49.4E	5	130	-	3	-1	Small gyre at ice edge visible on radar. [C1]
2200	80°57.9N	10°51.5E	5	130	-	3	-1	Ship drifting in very compact ice edge. Gyre still visible on radar. Composition as noted above.
18/08/93								
0330	80°58.7N	10°51.7E	0	-	-	-	-	Cover 90%. Brash between floes. Floe sizes: 20% 1-2 m, 70% 2-20 m. Up to 5% "dirty" ice, many pieces of drift wood. No melt pools, no ridging, no snow cover. Ship drifting in the ice. [C2, C3]
2200	80°52.2N	07°53.6E	4	190	1011	1	1	Ice edge visible on the radar. Approx 6 nm to Northeast, running East to West.
2300	80°56.6N	07°56.9E	3	199	1011	1	0	Compact ice edge at 80 59N 07 57E, not as compact as yesterday, cover 80%. Some streamers up to 100 m from main ice edge, made up of pieces up to 5 m diameter. Less brash than before. Floe sizes: 20% >20 m (max 50 m), 40% 10-20 m, 20% <10 m. Very low freeboard, melt pools, no pressure ridging. Some (5%-10%) "dirty" floes (particles).
2400	80°59.4N	08°02.8E	0	-	1011	1	-1	At ice edge. Composition as above. Drifting until 0700, 19/08/93. [C4, C5]
19/08/93								
0700	80°59.1N	07°50.5E	4	092	1012	0	-1	Drifted in small (2 nm) radius circle overnight. Moving West along ice edge reveals larger, less rotten floes than before.
0800	80°56.2N	07°27.1E	1	155	1012	0	-1	Ice edge entered. First-year ice up to 2 m thick, angular floes. 70%-80% concentration, 50% >10 m, 20% <10 m, 10% brash. Melt pools 5%-10%. Little ridging (5%). No snow cover, no thaw holes.
0900	80°57.9N	07°21.2E	1	142	1012	1	-1	Fine rain. Increasing proportion of old floes (up to 5%) and pieces of ridged ice, some floes now up to 50 m (very few, most floes 2-20 m), 5% dirty floes. Melt pools 20%. [C6, C7]
1010	80°58.6N	07°18.6E	-	-	1012	2	-1	Cover 90%. First-year ice, 65% F2, 10% F3; up to 2 m thick. Old ice, 5% F3, up to 4 m thick. Melt pools 20%. Some ridging, 5%. "Dirty" ice 5%.
1130	80°59.2N	07°15.7E	1	125	1012	2	-1	Cover 90%. First-year ice, F1 5%, F2 70%, F3 15%, up to 1.2 m thick. Melt pools 10%, "dirty" ice 5% (particles). Little (less than 5%) ridging.
1300	81°00.7N	07°12.7E	-	-	1012	0	-1	Cover 95%. First-year ice, F2 60%, F3 15%. Greater than 1.2 m thick. Old ice, F3 5%. Melt pools 10%, ridging 5%.
19/08/93								
1405	81°02.4N	07°09.4E	1	198	1012	0	-1	Cover 80%. First-year ice, F2 30%, F3 50%. Greater than 1.2 m thick. Melt pools 15%. No "dirty" ice. Little ridging. Very light wet snow falling. Visibility falling, now less than 1km.
1510	81°03.5N	07°08.6E	0	-	1013	0	-1	Cover 80%. First-year ice, F2 20%, F3 60%. Greater than 1.2 m thick. Melt pools 5%-10% No ridging, thaw holes, "dirty" ice. Drifting in ice while working on floe until...
20/08/93								
0100	81°04.3N	07°16.0E	5	220	1016	0	-1	JOIDES Resolution issues recall at 0115. Ice work abandoned.
0300	81°03.1N	07°16.9E	4	220	1017	0	-1	Cover 70%. First-year ice, F1 10%, F2 30%, F3 30%. Greater than 1.2 m thick. Melt pools 10%, ridging 5%.
0400	81°01.9N	07°16.4E	3	200	1017	0	-1	Cover 90%. First-year ice, F1 20%, F2 70%. Between 0.7 and 1.2 m thick. No melt pools, thaw holes, ridging or "dirty" ice. [C8]
0510	81°00.4N	07°18.2E	2	180	1018	0	-1	Cover 90%. First-year ice, F1 20%, up to 0.7 m thick; F2 70%, up to 1.2 m thick. Melt pools (5%) on larger floes.
0610	80°58.7N	07°21.6E	3	165	1018	0	-1	Cover 85%. First-year ice, F1 10%, F2 50%, F3 25%. Greater than 1.2 m thick. Melt pools 5%. No ridging, thaw holes or "dirty" ice. [C9]
0715	80°56.4N	07°28.3E	3	190	1019	0	-1	Cover 70%. First-year ice, F1 20%, up to 0.7 m thick; F2 50%, up to 1.2 m thick. No ridging, some melt pools (up to 5%) on larger floes. No "dirty" ice.

SEA ICE OBSERVATIONS LOG continued.

Time	Lat.	Long.	Spd.	Dir.	Press.	Air	Wtr.	Comments
0800	80°55.5N	07°28.3E	3	170	1019	0	-1	Ice edge exited. Compact. No swell. Edge runs East to West. 3.5 nm to East it turns North. To the West it starts to turn South (from radar).
20/08/93								
1200	80°14.2N	05°50.1E	2	040	1019	3	2	On station 10 nm from <i>JOIDES Resolution</i> . Ice cover (in isolated area) 5%–10%. Pieces of old ridges, up to 15 m long, several meters deep.
1300	80°14.2N	05°47.5E	3	276	1017	3	3	Drifting with ice area described above.
1600	80°17.5N	05°36.1E	9	139	1019	4	3	Drifting with ice described above. Wind beginning to disperse it. Drifting with remnants until...
2000	80°18.6N	05°28.4E	1	278	1020	4	4	
21/08/93 [A06]								
2400	80°44.3N	05°55.1E	5	035	1026	1	2	Large floe-berg (defined by Garrity and Ramseier [1992] as "a massive piece of ice composed of a hummock, or a group of hummocks, frozen together...") detected on radar, position calculated as 80 54.0N, 06 20.0E.
22/08/93 [A7–A9, B1]								
0100	80°47.6N	06°42.6E	4	273	1026	1	2	
0200	80°46.5N	07°29.6E	4	276	1026	1	2	
0300	80°46.2N	08°13.6E	4	273	1026	0	2	Ordered South by <i>JOIDES Resolution</i> . Ice watch abandoned.
0800	80°44.5N	09°51.9E	5	195	1025	4	2	Ice watch resumed. Ice edge visible on radar (approx 5 nm North) running to the West and turning to the North to the East. Appears (from radar again, to be compact).
0840	80°49.2N	09°39.1E	5	120	1025	1	1	Ice edge visible (just). Compact. Turning to run West along the edge.
1000	80°54.0N	09°07.8E	4	160	1025	1	0	Running Northwest along increasingly diffuse ice edge.
1100	80°59.9N	08°41.2E	4	103	1025	0	0	Ice edge diffuse. Up to 500 m from first ice until cover reaches 70%–80%. Apparently (from radar) becoming more compact to the West. Visibility continuing to decrease, falling to less than 200 m.
1200	81°02.8N	07°42.6E	5	130	1025	1	-1	Visibility less than 100 m. Ice edge invisible except on radar. Scattered ice pieces visible in water.
22/08/93								
1300	81°01.4N	07°06.5E	3	062	1025	0	-1	Ice edge just visible (visibility < 200 m) from the bridge, looks compact. Large return from floe-berg on radar, range 6.8 nm, bearing 227°. Moving Southwest along the ice edge.
1400	80°57.1N	06°20.4E	-	-	-	-	-	Close to floe-berg reported above. From radar, floe size is 0.2 × 0.5 nm. Moving at speeds up to 1 knot to Northeast. Too dangerous to go alongside or to land for sampling. Same as radar contact reported 2400, 21/08/93. Ice edge compact running to the West.
1500	80°57.1N	06°20.4	2	101	1025	0	-1	Visibility falls to less than 100 m. Ice edge visible only on radar.
1830	81°02.1N	04°58.0E	1	178	1024	2	-1	Entered ice edge moving North.
1900	81°02.8N	04°58.0E	0	-	1024	2	-1	Cover 95%. Floes less than 50 m diameter, most less than 20 m, much brash, no clear open water. Floes up to 4 m depth. Melt pools 20%. Ridging 20%. Moving alongside to deploy onto the ice.
2000	81°03.0N	04°58.6E	-	-	-	-	-	Ship drifting alongside floe until...
2200	81°03.7N	04°59.7E	-	-	-	-	-	First deployment completed. Second continues until...
23/08/93 [A10, B1, B2]								
0600	81°03.5N	05°14.0E	3	069	1023	1	-1	Deployment complete. Ice cover as described for 1900, 22/08/93.
0700	81°03.5N	05°14.0E	-	-	-	-	-	Exited very compact ice edge. Ice cover as above.
1600	80°30.9N	03°43.3E	5	095	1024	2	0	Ice edge running to the South. Diffuse. Visibility less than 100 m.
1700	80°27.3N	04°09.6E	5	140	1024	3	0	Long ice stream visible on radar, approx 6 nm long, running East to West from the ice edge. Well defined on radar. This position is approx West end position. Less than 0.5 nm wide.
1800	80°21.7N	04°11.2E	5	160	1024	3	0	Complex ice edge. Radar suggests banding of ice edge up to 6 nm in from the edge, bands approx 1nm wide, and 1 nm apart.
1900	80°13.5	04°33.1	9	116	1024	2	1	Visibility poor. From radar ice edge running to the East bearing 100°. After 2.75 nm bears 160°.
2000	80°07.8N	04°54.4E	8	170	1024	3	1	Ship moving South along the ice edge. Edge diffuse, cover 30%. Ice streams visible on radar to South and Southeast, 2–2.5 nm.
23/08/93								
2045	80°30.6N	04°38.2E	-	-	-	-	-	Very scattered ice edge, up to 3 nm from first pieces of ice to closed pack. Up to 30% cover at outer edge, most floes less than 10 m diameter, some 10% up to 20 m diameter. Many pieces of deep ridging visible.
2100	80°02.1N	04°20.7E	4	195	1024	4	0	Diffuse ice edge, 10% cover.
2200	79°58.9N	03°40.0E	5	160	1023	4	0	Diffuse ice edge. Visibility poor.
2300	79°59.2N	02°53.8E	1	170	1023	3	1	Diffuse ice edge. Visibility decreasing.
2400	79°55.7N	02°08.9E	4	160	1023	2	0	A few scattered floes in the water, less than 5 m diameter.
24/08/93 [A11, B2]								
0100	79°59.8N	01°34.2E	4	158	1022	2	2	Cover 30%–40%. Floes up to 20 m diameter.
0200	79°56.9N	01°49.8E	5	304	1023	2	2	Very poor visibility. Ice on radar but none visible except for a few pieces (less than 1 m diameter) in the water near ship.
0300	79°52.0N	02°36.3E	4	277	1023	2	1	Moving West. Ice "island" visible on radar. Approx 3 nm (East–West) × 5 nm (North–South).
0400	79°55.1N	03°10.1E	4	276	1023	3	1	Scattered patches of ice. Cover within these 90%–100%, floes less than 10 m diameter. Radar shows main North–South ice edge at this point with scattered areas of ice beyond. Visibility falls to less than 100 m.
1830	81°05.5N	07°03.6E	2	217	1021	2	1	Compact ice edge. 100% cover. Floes up to 50 m, a very few larger (not over 70 m). Very many pieces of old ridges, 10–15 m depth. No brash. 50/50 first-year/old ice. Melt pools up to 20%. Some (5%) "dirty" ice.

SEA ICE OBSERVATIONS LOG continued.

Time	Lat.	Long.	Spd.	Dir.	Press.	Air	Wtr.	Comments
1900	81°06.8N	06°59.5E	1	105	1020	1	0	Ice conditions as above. Ship maneuvering in this area until... Ship drifting with ice edge and floe-berg at this point until...
2100	81°06.5N	07°01.4E	0	—	1020	1	-1	
25/08/93 [A12, B3, B4]								
0800	81°06.6N	06°57.3E	2	080	1016	2	-1	Ice edge has become more diffuse overnight. Cover at edge now 60%–70%. Following ice edge to West. Cover at edge 50%–60%.
0900	81°06.6N	07°32.1E	4	312	1016	1	0	
1015	81°02.3N	08°22.6E	5	315	1016	1	-1	Scattered, diffuse ice edge, cover at edge now 30%–40%. Edge less well defined.
1110	80°57.2N	08°22.6E	4	300	1016	2	-1	Ice edge diffuse. Cover 30%–40%. Edge has moved North and West approx 10 nm in two days. [C10, C11]
22.30	81°06.4N	07°22.5E	4	220	1019	0	1	Very poor visibility, ice edge visible on radar only.
2400	81°07.0N	07°26.3E	0	—	1019	-1	0	Ice edge visible on radar only, 3.7 nm North.
26/08/93 [B5]								
0100	81°07.0N	07°28.8E	0	—	1019	-1	0	Monitoring ice edge, on radar only.
1130	81°08.6N	07°37.0E	6	160	1021	1	0	Monitoring ice edge since 2400, 25/08/93. Edge has moved 0.6 nm South since then.
1500	81°10.2N	07°32.5E	0	—	1021	2	1	Monitoring ice edge on radar.
1800	81°11.8N	07°29.0E	0	—	1021	2	0	Drifting. Ice to the North, East, and West (0.4 nm).
1900	81°11.3N	07°22.7E	2	038	1021	2	0	600 m in from ice edge. Large areas of open water, up to 700 m long.
27/08/93 [A14, B6]								
0400	80°20.8N	05°34.5E	—	185	1020	3	3	Ice edge on radar and in sight. Appears compact but with many bays/inlets.
0530	79°52.5N	04°39.0E	—	195	1020	4	4	
0600	79°47.7N	04°18.0E	—	180	1020	3	4	Compact ice edge visible, complicated with many twists and turns.
0700	79°49.3N	04°08.9E	—	190	1020	2	3	Compact meandering ice edge visible. Some "rafts" of ice, cover 10%, seen off the main edge.
0800	79°37.7N	04°40.7E	7	145	1020	4	2	A few scattered pieces in the water at this point, less than 5 m in diameter.
0920	79°42.8N	04°56.5E	5	165	1020	5	5	Moving through isolated and dispersed debris, floes up to 5 m diameter, cover up to 10%. Mostly remains of first-year floes. Band is approx 6 nm long, oriented North–South.
1020	79°40.1N	05°06.3E	5	165	1020	6	4	In open water.
1400	80°01.2N	05°18.2E	3	067	1020	3	4	Ice 1.4 nm due North. From radar it appears to be a diffuse band extending from the main edge (meandering East–West).
27/08/93								
1730	80°03.4N	05°29.4E	1	290	1020	3	2	Misty. Moving into diffuse ice edge, up to 50% cover at edge. Cover in from edge varying 20%–80%. Floe sizes, 25% 10–20 m, 25% 2–10 m. Little brash. Mostly rotten first-year ice. Some older floes (5%) and pieces of ridges. No snow cover.
2010	80°30.2N	05°35.3E	2	165	1020	4	2	Diffuse ice edge. First-year ice (floes F2), though some pieces of old(?) ridges 4–5 m thick. [C12, C13]
2115	80°01.9N	05°27.5E	2	165	1020	4	2	Ice edge. Floe size: 2–20 m. Cover 60%. Visibility poor. Monitoring ice edge until...
28/08/93 [A14, B7]								
0400			1	084	1019	4	2	Ice edge. Floe size 2–30 m, cover 60%. More, larger floes than previous observation, some pieces of old, deep, ridging. Visibility poor.
0500	79°59.1N	01°28.6E	1	084	1019	4	2	Ice as above observation.
0600	79°59.8N	05°37.4E	4	236	1019	4	2	At ice edge. Ice observation as at 0400.
0700	79°58.8N	05°29.8E	6	054	1020	4	3	Ice edge. Observations as at 0400. Cover 50%.
0800	79°58.5N	05°25.4E	8	170	1019	4	2	In ice. Cover 60%–70%. Floes up to 30 m diameter. Old ice, up to 4 m thick, 20% pieces of old ridges. Visibility poor.
0900	79°58.3N	05°26.8E	8	160	1019	4	2	In ice. Observations as at 0800 until...
1300	79°57.9N	05°26.8E	7	172	1020	4	3	Visibility very poor, less than 150 m. Alongside large floe, old ridge. Captain estimates 30 m × 20 m × 15 m deep. Cover and observations as at 0800.
1400	79°57.5N	05°26.8E	2	165	1020	4	3	Cover up to 60%. Most floes in range 10–20 m, up to 4 m thick. Very poor visibility.
28/08/93								
1500	79°57.5N	05°26.8E	2	165	1020	4	3	At scattered ice edge. Floes 10–20 m, 4–5 m thick. Individual floes marking ice edge, no brash.
1600	79°56.5N	05°25.1E	7	180	1021	5	3	A few isolated ice pieces in the water, less than 5 m diameter. Visibility less than 150 m.
1700	79°58.2N	02°25.3E	7	182	1020	5	2	Visibility less than 100 m. Radar shows ice to North, with small band extending to East and South around this position, approx 4 nm long, 0.5 nm wide from radar.
1900	80°05.1N	05°53.2E	7	160	1020	6	4	Visibility poor. Ice edge 2 nm to West, running North–Northeast to South–Southwest, from radar only.
1944								Scattered ice edge visible. Poor visibility. Best guess gives cover 30%–40%, floes up to 10 m diameter. Appears low in the water.
2010	80°13.7N	06°07.4E	6	160	1021	7	4	Skirting edge of ice band (the edge itself?). Ice very scattered, appears to be less than 5 m diameter. Visibility less than 500 m.
2100	80°20.1N	06°18.7E	5	197	1021	6	4	North of ice band, in open water. Ice edge 1.8 nm to North, bearing 320°.
2200	80°29.6N	06°37.7E	7	170	1021	7	2	Compact ice edge visible to East.
28/08/93								
2300	80°36.9N	07°17.2E	6	170	1021	5	2	Passing small "island" of ice. Edge appears to have moved 20 nm to East since previous visit to this area. Edge now much less well defined. Cover 30%–40%, floes up to 10 m diameter, appear rotten.

SEA ICE OBSERVATIONS LOG continued.

Time	Lat.	Long.	Spd.	Dir.	Press.	Air	Wtr.	Comments
29/08/93 [B8-B10]								
0200	81°10.5N	06°39.4E	7	160	1021	3	2	Ice edge visible on radar approx 1.5 nm North. Appears compact and runs Northeast-Southwest. Visibility less than 100 m.
0400	81°08.8N	07°12.7E	3	165	1021	2	0	Following ice edge, now running North-South. Visibility less than 100 m. Cover at edge 30%-40%.
0500	81°12.2N	07°06.4E	5	210	1021	2	0	Ice edge 2 nm to West (running North-South). Running East-West 3 nm ahead. Clearly defined on radar, and just visible.
0600	81°15.3N	07°20.1E	7	172	1021	2	0	Compact ice edge clearly visible. Running East-Northeast to West-Southwest. Cover 100%. Many pieces of ridging, large individual blocks, etc. No melt pools evident. Contrast too poor to give better assessment. Ship estimates ice moving 0.7 knots to East.
0700	81°16.7N	07°55.5E	2	253	1021	2	-1	Ice edge compact. Large floe-berg encountered (previously encountered) range 1 nm, bearing 330°.
0800	81°17.9N	08°19.4E	1	290	1022	2	-1	Ice edge. Approx 1.5 nm to West ice edge turns to run Northwest-Southeast (from radar).
0900	81°17.1N	08°00.7E	4	057	1022	2	-1	Following ice edge, compact.
1100	81°07.0N	07°02.3E	4	333	1022	3	-1	North-South ice edge diffuse, 30% cover. Ice stream at 030° to main ice edge, up to 5 nm long and 1 nm wide. Cover within this 50%, floes 0.5-15 m diameter.
1630	81°12.4N	08°51.1E	5	175	1023	2	0	Compact ice edge at this point 90%-100% cover. 30%-40% old ice. Many pieces of large ridges, large blocks, etc. About 10% "dirty ice." First brown banding seen in upturned floe. Radar suggests edge to the West breaks up, 60%-70% cover at the edge. Large floe-berg on radar, range 10 nm, bearing 277°, (previously encountered), inside ice edge.
1800	81°17.7N	07°50.8E	6	235	1023	2	-1	Large floe-berg (noted at 1600, 29/08/93) 200 m inside compact ice edge at this point, 95%-100% cover. Up to 15% ridged ice.
1900	81°15.2N	07°08.0E	3	005	1023	2	-1	Ice edge. Compact. Floe size 2-20 m. Rubble on surface of floes. 5% melt pools. Much brash between floes. [C14, C15, C16, C17]
1930	81°14.6N	06°59.7E	-	-	-	-	-	Ice streamer crossed. Scattered floes, up to 20 m diameter. Cover less than 5%.
2000	81°12.7N	06°56.6E	3	315	1022	2	-1	Scattered pieces of ice, less than 10% concentration.
2110	81°05.6N	07°19.3E	4	337	1023	3	-1	Cover 20%. Floe size 1-10 m, exceptionally 20 m. Some floes up to 4 m deep.
30/08/93 [A15, B11, B12]								
1000	81°00.6N	07°13.6E	4	195	1029	3	1	Ice edge. Cover 60%. Floe size 2-10 m. 5% ridging.
1100	81°04.2N	07°13.6E	3	160	1022	3	0	Ice edge. 50%-60% cover. Floe size 2-10 m, some ridging (5%). First-year ice. Cover falls to 30%-40% approx 0.5 km inside ice edge. [C18, C19]
1300	81°03.6N	07°03.1E	4	193	1021	2	0	At ice edge. Cover 60%. Floe size 2-10 m. First-year ice, no melt pools. Little evidence of ridging.
1400	80°53.9N	06°24.0E	4	205	1022	2	0	At ice edge. Cover 60%. First-year floes, up to 30 m diameter. Some melt pools (10%), and ridging (10%). Little or no brash.
1500	80°54.2N	05°52.5E	4	314	1021	3	1	Diffuse ice edge. Less than 40% cover.
2210	80°02.6N	05°36.7E	5	031	1019	3	5	Scattered ice edge visible.
31/08/93 [A16, B13]								
0910	79°51.2N	04°27.0E	5	085	1018	3	1	Ice edge, compact, visible 2.5 nm to West.
0940	79°49.0N	04°01.9E	-	-	1023	3	2	Ice edge. Composed of floes less than 10 m diameter and brash, compact. From radar it appears that this is part of ice streamer, diffuse at its Eastern tip but apparently compact everywhere else.
1030	79°43.0N	03°43.4E	4	345	1018	2	1	At compact ice edge. Floe size less than 5 m. Much brash.
1105	79°39.6N	03°51.5E	1	342	1018	3	0	To East of ice edge. Edge less compact than previous note, now 60% cover. "Edge" is series of winding, but distinct streamers.
1300	79°33.6N	03°35.3E	5	140	1017	2	0	Scattered pieces, size less than 5 m, visible in the water. Scattered ice edge visible on radar.
1400	79°34.0N	02°47.6E	5	033	1017	2	0	Ice edge visible on radar, cover 50%-60%? Scattered pieces visible in water, size less than 5 m.
1735	79°26.1N	03°40.5E	-	-	-	-	-	Scattered pieces visible in water, size less than 10 m. Coverage rises to 10% in small areas.
<i>Fennica</i> running a transect through the previously mapped ice edge to characterize the area. Ice watch every 30 minutes.								
1830	79°24.3N	03°04.5E	-	-	-	-	-	Ice edge. Scattered. First-year ice. Floe sizes: 30% F1. Floes up to 1.2m thick. No melt pools. No thaw holes. No snow cover. No deformation or "dirty" ice visible.
1900	79°24.4N	02°57.1E	2	103	1016	2	1	In ice tongue at ice edge, scattered. Floe sizes: 5% F1, up to 0.7 m thick, 25% F2, up to 1.2 m thick. First-year ice. Other conditions as noted above.
1930	79°24.6N	02°49.1E	-	-	-	-	-	Edge of ice tongue (from radar). Observations as above. [C20, C21]
2000	79°25.3N	02°36.6E	4	117	1016	2	1	Out of ice tongue. Single large piece of old "dirty" ice visible (particles). First-year ice. Cover 5%, F2. No melt pools, thaw holes or snow cover. Floes up to 1.2 m thick.
2030	-	-	-	-	-	-	-	In open water.
2100	79°27.9N	02°10.8E	4	028	1016	1	0	Approaching ice edge from South. First-year ice. Cover less than 5%, F2. Other observations as above.
2130	79°29.1N	02°12.2E	-	-	-	-	-	Approaching ice edge. First-year ice. Cover 10%. Floe sizes: 3% F1, 7% F2. Up to 1.2 m thick. No melt pools, thaw holes, or snow cover.
2200	79°30.3N	02°14.2E	3	260	1016	1	0	First-year ice. Cover 15%, F1, up to 0.7 m thick.
2230	79°31.3N	02°17.6E	-	-	-	-	-	About to move into open water "inlet" in the ice edge. First-year ice. Cover 25%. Floe sizes: 5% F1, up to 0.7 m thick, 20% F2, up to 1.2 m thick. No melt pools, no snow cover, no thaw holes. No "dirty" ice visible.
2300	79°32.5N	02°20.4E	4	203	1016	2	0	In open water. Crossing "inlet" approx 1.7 nm wide and 2.5 nm long.

SEA ICE OBSERVATIONS LOG continued.

Time	Lat.	Long.	Spd.	Dir.	Press.	Air	Wtr.	Comments
2330	79°34.4N	02°26.7E	–	–	–	–	–	Moved back into the ice edge. First-year ice. Cover 40%. Floe sizes: 5% F1, up to 0.7 m thick, 35% F2, up to 1.2 m thick. Other observations as noted at 2230 above.
2400	79°35.3N	02°29.8E	1	208	1016	1	0	First-year ice. Cover 70%. Floe sizes: 10% F1, up to 0.7 m thick, 30% 2–20 m, up to 1.2 m thick, 30% F2, over 1.2m thick. Some ridging present, less than 5%. [C22, C23]
01/09/93 [A17, A18, B14] 0030	79°36.2N	02°31.8E	1	247	1016	1	0	500 m inside diffuse ice edge. First-/second-year ice. Cover 40%. Floe sizes: 30% F2, up to 2 m thick, 10% F3. No snow cover, no thaw holes. Melt pools 5%. Some ridging (5%), mostly the larger floes. Perhaps 1% "dirty" ice (particles).
0100	79°36.8N	02°35.9E	1	256	1016	1	0	Cover 70%. First-year ice. Floe sizes: 30% F2, less than 1.2 m thick, 30% F2 greater than 1.2 m thick. Gray, low in water, flooded around edges. Old ice (10%), F2, mostly ridged pieces. Melt pools 15%. No snow cover or thaw holes.
0130	79°37.4N	02°38.1E	–	–	1016	1	0	Cover 60%. First-year ice. Floe sizes: 40% F2, up to 1.2 m thick, 15% F2, greater than 1.2 m thick. Old ice 5%, F2, greater than 2 m thick. Some ridging (10%). Up to 10% melt pools, no snow cover, no thaw holes. No dirty ice.
0200	79°37.4N	02°40.8E	1	246	1016	1	–1	Cover 80%. First-year ice, 65% F2, greater than 1.2 m thick. Old ice 15% F3, greater than 2 m thick. Ridging 5%, 1% "dirty" ice (particles). Melt pools 5%. Concentrated band, approx 500 m wide at ice edge, visibly less concentrated to West.
0230	79°38.2N	02°44.3E	1	253	1016	1	0	Cover 90%. First-year ice, 70% F2, greater than 1.2 m thick. Old ice, 20% F3. Greater than 3 m thick. No melt pools, no thaw holes. Many remnants of pressure features in this area. Ridging 15%. "dirty" ice, 2%. [C24, C25]
0300	79°38.5N	02°46.8E	4	189	1016	1	0	Cover 85%. First-year ice, F2 65%, greater than 1.2 m thick. Old ice, 25% F3, greater than 3 m thick. 20% melt pools. Still in concentrated band between ice edge and more open pack to the West.
0330	79°39.0N	02°47.6E	–	–	1016	1	0	Cover 80%. First-year and old ice each, 40% F2, up to 4 m thick. Many large pieces of old ridging present (20%). Melt pools 10%.
0400	79°39.4N	02°49.1E	1	242	1016	1	0	Cover and ice types as above. Less ridging, no melt pools, some "dirty" ice. [C26]
0430	79°39.7N	02°52.6E	3	278	1016	1	0	Ice types as 0400, cover now 60%. Bands of varying concentration approx 200 m from ice edge. [C27]
0500	79°39.8N	02°55.6E	1	267	1016	1	0	Cover 50% First-year ice, 40% F2. Old ice, 10% F2. Less thick pieces than before. No melt pools, snow cover, or thaw holes. Little ridging evident (less than 5%). At the ice edge.
0530	79°40.2N	03°01.4E	1	253	1016	1	0	Cover 10%. First-year ice. F1 up to 1.2 m thick.
0600	79°40.9N	03°07.5E	1	254	1016	1	–1	Cover 10%. Small floes (F1) and brash up to 1.2 m thick.
0630	79°41.3N	03°10.6E	–	–	–	–	–	Ice edge. Cover 10%. Long swell.
0700	79°41.7N	03°19.1E	2	263	1016	1	–1	Open water.
0730	79°42.5N	03°25.6E	–	–	–	–	–	Cover 15%. F1, up to 1.2 m thick. Mostly brash, a few 2-m floes.
0800	79°42.8N	03°31.4E	1	251	1017	1	–1	Open water. Ice observations finish.
1900	80°57.0N	07°01.1E	3	030	1017	0	1	Ice edge. Complex edge. Initial cover 10%, F2, up to 2 m thick. Some pieces of ridging visible. Area of higher concentration visible 2 nm to Northwest. Appears to be one of several tongues of ice, 2–3 nm wide, running North–South. Cover in tongues up to 80%.
1930	80°58.9N	07°03.0E	–	–	1017	0	2	Scattered ice edge visible 0.5 km North. Coverage 60% at edge rising to 100% over 1 km. Floe size 2–20 m. Pieces of ridging visible.
2400	80°55.5N	08°19.3E	4	262	1017	–2	2	Diffuse ice edge visible to West. Cover 40%.
02/09/93 [B15] 0200	81°02.6N	07°41.1E	3	180	1017	–3	1	Monitoring ice edge since 2100, 01/09/93. Scattered areas of open pack; cover varies between 10% and 90%. Bands of high concentration mixed with others of much lower concentration. A few pieces of larger ridging visible. Visibility poor.
1200	80°39.0N	05°46.4	10	230	1017	–4	2	Conditions deteriorating. Wind speed rising, snow, temperature falling. Ice edge on radar.
1600	80°50.4N	07°21.4E	–	–	1015	–5	2	Bands of old ice, cover 100%, floes up to 30 m in length, though most (80%) in range 2–20 m. Most floes thicker than 2 m. Bands cover perhaps 10% of visible area.
03/09/93 [B16]								
Ice edge position given on ship's chart, drawn from radar due to extremely poor visibility.								
04/09/93 [A19–A21] 0245	78°51.7N	02°28.3E	11	330	1009	–1	3	Cover up to 30%, generally 10%–20%. Scattered patches of ice, Pieces up to 5 m diameter.
0300	78°51.3N	02°27.2E	11	340	1009	–1	3	Two ice rafts each 400–500 m long encountered in otherwise open water.
0500	78°48.2N	02°12.6E	–	–	1009	–1	2	Several "rafts" of wind herded ice visible. Cover up to 70% in the small areas covered, much less than 5% total coverage. Ice in these "rafts" less than 10 m diameter, appears less than 2 m thick. A few (up to 20 m diameter) isolated pieces of multi-year ice visible. Visibility a few km.
1220	78° 47.5N	02°59.0E	15	000	1007	0	3	In open water.
1500	78°50.2N	01°48.2E	12	300	1008	0	4	Approaching band of ice, oriented North–South. Scattered pieces, less than 3 m diameter, and approx 1 m thick. Band is greater than 6 nm long (from radar) and approx 500 m wide. 2-m swell from North.
1600	78°48.5N	01°41.5E	13	310	1007	–1	1	Drifting with ice band, description above. Wind and swell from the Northwest.

SEA ICE OBSERVATIONS LOG continued.

Time	Lat.	Long.	Spd.	Dir.	Press.	Air	Wtr.	Comments
1700	78°47.6N	01°40.8E	13	320	1007	-1	1	Above band consists of areas of higher concentration, up to 70%, linked by areas of lower, 5%, as little as 1% in places.
1925	78°44.5N	01°38.9E	13	320	1007	-1	2	Ice edge on radar to East. Ice just visible in poor light, appears to be in rafts, hundreds of meters long.
05/09/93 [A22] 1835	78°57.7N	01°26.4E	5	010	1004	-2	2	Diffuse ice edge visible to West. Cover at the edge 40%. A few scattered pieces (up to 4 m diameter) visible in the water. Visibility less than 1 km.
2005	79°09.2N	01°55.8E	10	340	1005	-1	0	Radar gives scattered ice 6.5 nm, bearing 270°. No visual confirmation.
06/09/93 [A23, A24] 0200	79°57.3N	03°28.1E	5	234	1003	-3	4	Diffuse ice edge. Areas of 60% cover mixed with areas with as low as 10%. A few scattered floes in water off the main edge.
0230	79°57.6N	04°03.8E						Radar suggests ice edge to East of this point.
0300	79°57.0N	04°18.9E	5	281	1002	-2	2	A few scattered ice floes in water (up to 5 m diameter). Radar contact of 0230, above.
0500	80°07.3N	05°12.2E	4	261	1002	-2	4	No ice visible. Radar returns from 6 nm West.
1110	79°58.1N	04°44.8E	0	-	1003	-2	3	Ice on radar, 2 nm. Isolated large floes?
1300	80°10.3N	05°04.3E	7	340	1003	-2	5	Scattered floes, 2–20 m diameter, in water. Radar gives ice 4 nm to West. Visibility less than 1 km.
1400	80°18.8N	05°01.1E	0	-	1002	-2	5	Following ice edge.
1500	80°19.9N	05°48.6E	0	-	1002	-2	4	Diffuse ice edge running Northeast–Southwest. Light snow. Visibility less than 1 km and decreasing.
1710	80°09.7N	07°12.7E	5	235	1002	-1	3	Very diffuse ice edge, 20%–30% total cover (in some areas 100% cover). Appears to be composed of first-year ice, up to 10 m in diameter. Some remnants of ridging.
1910	80°18.3N	08°15.5E	4	193	-	-	-	Diffuse ice edge, 30% cover. To East is tongue of high concentration, 6 nm long. To West is very scattered edge, isolated floes up to 5 m in diameter. Areas of brash 40–50 m long, 10–20 m wide. Visibility less than 2 km.
1945	80°20.5N	08°33.4E	4	220	1003	-2	2	Alongside raft of floes, concentration up to 50%. Floes up to 10 m diameter, 4 m thick. Some surface topography. Mixture of old and first-year ice. No swell. Very diffuse ice edge visible 2 nm to Northeast. Old ice, surface has “jumbled” appearance, suggesting pieces of ridging/blocks. Floe size 2–20 m, exceptionally larger floes. Visibility 4 km.
2200	80°32.0N	08°22.5E	2	340	1003	-1	2	Open pack. Cover 10%–30%, floes, no brash. Old pieces of ridge, first-year ice (up to 2 m thick), some melt pools (5%). Old ice up to 30 m diameter, thickness greater than 4 m.
2315	80°36.3N	08°10.0E	2	150	1003	-2	2	Open pack. Cover up to 40%. First-year ice up to 2 m thick, very flat, no deformation. Melt pools 10%. No “dirty” ice. Some thaw holes.
07/09/93 [A25] 0015	80°38.8N	08°07.0E	2	058	1003	-3	2	Cover rises to 90% at this point. Composition as 2200, 06/09/93. Northwards passage made through “lead” of much lower cover than surrounding areas. Estimated width 1 km, with only scattered (although often large) floes.
0200	80°34.5N	07°44.2E	1	021	1003	-2	2	Cover 40%–50%. First-year ice, rotten. Smaller floe size than previously noted, 2–20 m diameter. No deformation, “dirty” ice, or thaw holes. Thickness 1–2 m.
0300	80°32.0N	07°42.3E	1	359	1003	-1	2	Cover 30%–40%. First-year ice, F2 30%, up to 2 m thick. Old ice up to 5 m thick, F2 10%. Melt pools 10%. Ice very flat, little freeboard.
0730	80°26.8N	07°29.4E	1	092	-	-	-	Cover 20%–30%. Composition as above. Increased surface deformation present.
0840	80°26.7N	07°08.2E	-	-	-	-	-	Cover 40%. First-year ice, F1 5%, F2 35%. Thickness greater than 1.2 m. Melt pools 20%. No thaw holes, “dirty” ice. Snow cover 1–2 cm. Some melt pools snow covered. Ridging 5%. [C28]
0900	80°26.6N	07°05.9E	5	320	1003	-3	1	Cover 20%. First-year ice; F1 5%, up to 1.2 m thick; F2 20%, thickness greater than 1.2 m. Snow cover 1–2 cm. Melt pools on larger floes, 5%. Ridging 15%. [C29]
0940	80°26.2N	06°55.1E	-	-	-	-	-	Cover 60%. First-year ice. Floe sizes: F1 10%, F2 50%. Melt pools 10%. Ridging 20%. Snowing gently.
1000	80°26.0N	06°47.9E	-	-	-	-	-	Cover 30%. First-year ice. Floe sizes: F1 5%, F2 25%. Thickness up to 1.2 m. Ridging less than 5%. Melt pools 5%. No “dirty” ice, no thaw holes. Snow cover 1 cm.
1020								Cover varying from 10%–50%. Average floe size increasing. Some floes up to 50 m in diameter, exceptional. All of these larger floes are multi-year, 5 m+ thick. Little ridging.
1035	80°26.2N	06°41.4E	-	-	-	-	-	Cover 25%. First-year ice. Floe sizes: F1 5% up to 1.2 m thick; F2 15%, F3 5%, thickness greater than 1.2 m. Ridging 5%. Melt pools, 10% on F2 and F3. Snow cover 1 cm.
1044	80°26.2N	06°39.1E	-	-	-	-	-	Entering area of higher concentration. Cover 60%–70%. Floe size decreasing, in range 2–20 m. Average floe size 10 m. Little pressure ridging. Pattern of melt pools suggests second-year ice. Melt pool coverage 10%.
1100	80°26.3N	06°34.8E	-	-	-	-	-	Cover 60%. First-year ice. Floe sizes: F1 5%, up to 1.2 m thick; F2 55%, greater than 1.2 m thick, melt pools 10%–15%. Snow cover 1 cm. Floes typically rounded edges. No dirty ice, thaw holes. Increasing amounts of brash/small distinct pieces in the water. Surfaces “smooth” and undulating.
1115								Cover increasing to 70%–80%. Mixture of first- and multi-year ice. Pressure ridging 15%.
1130	80°26.1N	06°26.3E	-	-	-	-	-	Cover 80%. Floe sizes: F1 10%, F2 70%. Melt pools 5%. More broken up, smaller average floe size. More compact. [C30, C31]
1200	80°26.1N	06°20.7E	5	300	1004	-2	1	

SEA ICE OBSERVATIONS LOG continued.

Time	Lat.	Long.	Spd.	Dir.	Press.	Air	Wtr.	Comments
08/09/93 [B17, B18] 0700	80°24.2N	06°48.9E	5.2	231	1002	-1	0	Drifted Southeast during the night. Visibility much decreased. Ice concentration now 100% around the ship. Floe size F2. Composition as before.
0805	80°23.7N	06°48.6E	-	-	1002	-1	-1	Cover falls from 80% to 10%–20% at this point. Floe size 2–20 m, ratio of first-year to multi-year ice approx 4:1. Ridging 5%. Melt pools 5%–10%. No dirty ice. Visibility less than 1 km.
0840	80°22.7N	06°45.8E	3	240	1002	-1	0	Cover 30%–40%. First-year and multi-year ice. Floe size 2–20 m. Some pieces of old ridging. Melt pools 5%.
0900	80°22.2N	06°43.4E	6	250	1002	-1	0	Compact ice edge. Cover in band (100–200 m wide) at ice edge 90%. Cover behind band 20%–30%. Floe size 2–20 m, mixture first- and multi-year ice. Larger floes in ice edge (10–20 m size) all multi-year. Ridging 10%. No ridging, no thaw holes, no melt pools. No swell. Up to 50 m of ice band at edge overwashed by sea. Much brash in this band. [C32]
0930	80°21.9N	06°39.0E	-	-	1002	-1	0	Compact ice edge. Visibility falling. Edge looks similar to description above. Band 90%–100% cover, 100–200 m wide at edge, 20%–40% cover behind. Bights in ice edge typically a few 100 meters. A few pieces of ice (size up to 0.5 m) off the main edge.
1000	80°23.0N	06°27.3E	6	280	1002	-2	0	Compact ice edge with many small bights. Composition as above. Visibility less than 300 m.
1030	80°24.1N	06°15.3E	9	273	1002	-2	1	Ice edge becoming increasingly scattered, more small pieces in the water. Compacted band now less than 50 m wide.
1100	80°25.7N	06°04.0E	6	276	1002	-3	1	More diffuse ice edge. Floe size 2–20 m. Compacted band at the edge is now less than 30 m wide. Visibility clearing. Small pieces (brash) in area up to 200 m in advance of the main edge. Areas behind compacted band "patchy," cover 50%, average. Ridging less than 5%. Snowing. Ice edge shows turn to North at 80°26.3N, 05°45.0E.
1130	80°26.2N	05°46.5E	5	265	1002	-3	1	Edge compact, no longer brash pieces in water off main edge. Cover at edge 60%. Smaller average floe size, say 10 m. Floes in size range 2–20 m. Distinct (on radar) lead running to the North at this point. Estimate up to 2 nm at South end and at least 7 nm long, North edge not visible on radar.
1200	80°28.0N	05°35.1E	-	-	1001	-3	2	In open water of lead. <i>JOIDES Resolution</i> issues recall to scout YERM 2A and YERM5 sites.
1255	80°29.9N	05°45.5E	4	220	1002	-3	3	Scattered ice edge visible (just) in decreasing visibility. Floe size range 2–20 m. Radar suggests main ice edge 4 nm West of these scattered floes.
1500	80°04.7N	04°47.7E	6	260	1002	-3	3	Moving South, following very diffuse ice edge, cover 10%. Visibility poor (<500 m) but improving. Cover in from edge rises to 60%. Floe size F2. Outer edge is made up of small, low freeboard floes.
1520	80°02.1N	04°36.8E	-	-	-	-	-	Scattered pieces up to 20 m diameter in water away from the main ice edge. Some areas of ice rafts just visible, overall cover off main edge 1%.
1900	79°55.8N	06°23.8E	7	350	1004	-1	3	Completing circuit of Site YERM 2A.
2340	79°57.8N	04°21.7E	6	320	1006	-4	3	Entering diffuse ice edge, 10% cover at edge, rising to 40% over 1 km. Rotting first-year floes (F2), mostly less than 10 m in diameter. No ridging, melt pools, "dirty" ice or thaw holes.
09/09/93 [B18–B20] 0730	79°53.4N	02°01.3E	7	225	1009	-4	0	Approaching cover 90%–100%. Floe size F2, and F3. Ice station on flow greater than 1 km diameter. Ridging 10%. Many melt pools (all frozen), 40%. Snow cover 2 cm. Deployed on large floe until...
1245	79°45.7N	02°08.2E	8	210	1010	-4	0	Running South–Southeast in "lead," scattered floes less than 3 m diameter, approx 1 km wide. Cover in surrounding area 30%–40%.
1400	79°42.3N	02°59.4E	7	220	1011	-1	1	
1730	80°01.7N	05°21.5E	4	276	1012	-3	2	YERM 2A clear of ice.
1900	79°59.0N	06°10.2E	3	300	1012	-3	2	
2200	80°15.4N	05°51.8E	4	310	1014	-5	3	Very distinct ice edge visible on radar. Just visible on horizon 4 nm to North. Edge runs Northeast to Southwest.
2300	80°19.2N	05°57.7E	2	290	1014	-5	3	Reached ice edge seen above. Edge compact, too dark to see composition. Cover 70%. Edge appears to be complex series of bays. Floe size F2. Areas of open water apparent behind main edge. Remaining at edge until tomorrow morning.
2400	80°20.2N	06°06.1E	3	254	1015	-5	3	Edge more diffuse than above. Appears to become more diffuse to the East. Floe size F2. Cover 60% maximum but patchy, perhaps as low as 10% in places.
10/09/93 0745	80°14.1N	06°37.3E	0	-	1018	-4	0	Ice edge has curved to South during the night. Now in position off a band running West. 20%–40% concentration with blocks and old pieces of ridge.
0900	80°23.3N	06°41.0E	0	-	1019	-4	1	Moving North to investigate edge more closely. Series of inlets running into ice edge.
0940	80°26.5N	06°43.4E	-	-	-	-	-	Stationary at ice edge. Cover 70%. Floe size 2–20 m. Band of lower concentration (20%) to the Northeast, running parallel to the edge.
1000	80°26.9N	06°43.6E	3	230	1019	-3	0	Moving into ice, bearing 020°.
1030								Cover 70%. Evidence of new ice formation. Gray ice 5–10 cm thick. Snow cover less than 5 cm.
1100	80°29.3N	06°47.4E	3	180	1019	-1	0	Cover 15%. First-year ice. Floe sizes: F2 10%, F3 5%. Greater than 1.2 m thick. Snow cover up to 5 cm. Moving through area of low concentration. Previously moving through area of 70% cover with evidence of new ice formation. Ridging 10%. Visibility varying, up to 3 km.

SEA ICE OBSERVATIONS LOG continued.

Time	Lat.	Long.	Spd.	Dir.	Press.	Air	Wtr.	Comments
1130	80°31.0N	06°51.7E	--	--	--	--	--	Cover 25%–30%. Young ice, F1, less than 5%. First-year ice; F1 15%, F2 10%. Melt pools 10%. First signs of new ice formation.
1245	80°32.9N	07°00.6E	--	--	--	--	--	Cover varying from 50% to 80%. First- and multi-year ice. Floe sizes F2 and F3. Ridging 20%. Melt pools 20%. All melt pools frozen. Gray ice at the edges of floes makes up some 5% of total cover. Large floe-berg visible on horizon, sikussak?
1400	80°31.6N	07°03.3E	0	--	1020	-2	-1	Cover up to 70%, changing rapidly. Young ice F1 and F2, up to 10%, 5–10 cm thick. Gray matt appearance. First-year ice, F2 20%, F3 40%. Thickness greater than 1.2 m. Melt pools 10%. No "dirty" ice, thaw holes. Ridging 5%–10%. [C33]
1425	80°30.9N	07°03.4E	1	016	1020	-1	-1	Ice edge. Cover falls from 50% to 60% to 10%. Floe size changes from F3 multi-year to F2, still mostly multi-year but some first-year. Ridging 10%, hummocks 10%, melt pools 10%.
1645	80°28.4N	07°02.6E	--	--	--	--	--	Cover 30%. First-year ice. Floe sizes: F2 15%, F3 15%. Thickness greater than 1.2 m. Melt pools 10%. Snow cover up to 5 cm. Ridging 15%. Approx 1 km from ice edge.
2010	80°27.4N	06°38.7E	2	076	1021	-2	1	Moving in area of 10% cover. Ice edge diffuse. Floe size F2. Mixture of first and multi-year ice.
11/09/93								
0110	80°22.4N	05°44.4E	2	031	1021	0	2	Following ice edge until evening meeting with <i>JOIDES Resolution</i> . Edge is well defined, cover 50%. Complex edge with many bays.
0400	80°12.9N	05°27.9E	7	200	1021	0	2	
0800	80°06.0N	05°47.0E	4	190	1022	1	2	
0900	80°00.3N	06°22.3E	8	160	1022	3	2	Circling YERM 2A. No ice visible.
1020	79°50.3N	06°01.8E	0	--	1022	3	2	
1220	80°00.6N	05°12.2E	6	200	1021	2	1	Stationary monitoring ice tongue. Compact ice edge of approx 90% cover. Old ice, greater than 2 m thick, 2–20 m diameter. Pieces of pressure ridging and rubble.
1400	80°01.6N	05°13.9E	5	180	1021	1	2	Monitoring ice edge. Compact edge, 70% cover of 2–20 m floes. Mixture of brash and overwashed first and multi-year floes.
1600	80°03.2N	05°14.4E	6	180	1020	2	0	
1815	80°05.0N	05°15.1E	1	219	1020	0	1	Monitoring ice edge as above.
2000	80°06.6N	05°17.4E	7	210	1020	-1	1	
2145	80°20.3N	05°03.7E	4	034	1020	-2	1	Monitoring compact ice edge. Pieces (up to 0.5 m) in water off main edge, to a distance of 100 m. Composition impossible to assess in poor visibility/twilight. Cover 80%–100%, small floes, up to 20 m diameter.
2330	80°00.3N	05°01.2E	6	230	1020	-2	1	Following compact ice edge.
12/09/93								
0215	80°00.6N	05°06.5E	4	225	1020	-2	1	Monitoring compact ice edge at this point. Cover 80%–100%. Visibility less than 200 m. A few small streamers of ice pieces (up to 0.5 m) in water off edge. <i>JOIDES Resolution</i> at YERM 2A.
2000	79°57.2N	04°08.4E	4	290	1017	-5	3	Skirting ice edge. Cover at ice edge 80%, band of lower density (25% cover) 200–300 m behind edge. Small bands of brash and grease ice around ship. No swell.

APPENDIX A
Satellite Images

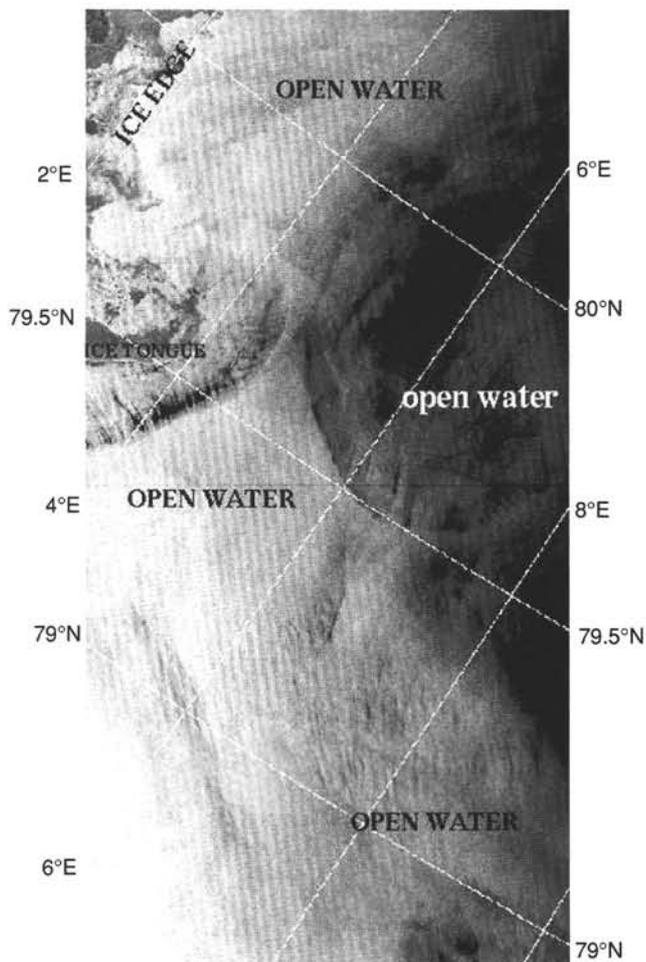


Figure 1. Satellite image; 11/08/93, 20:40; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

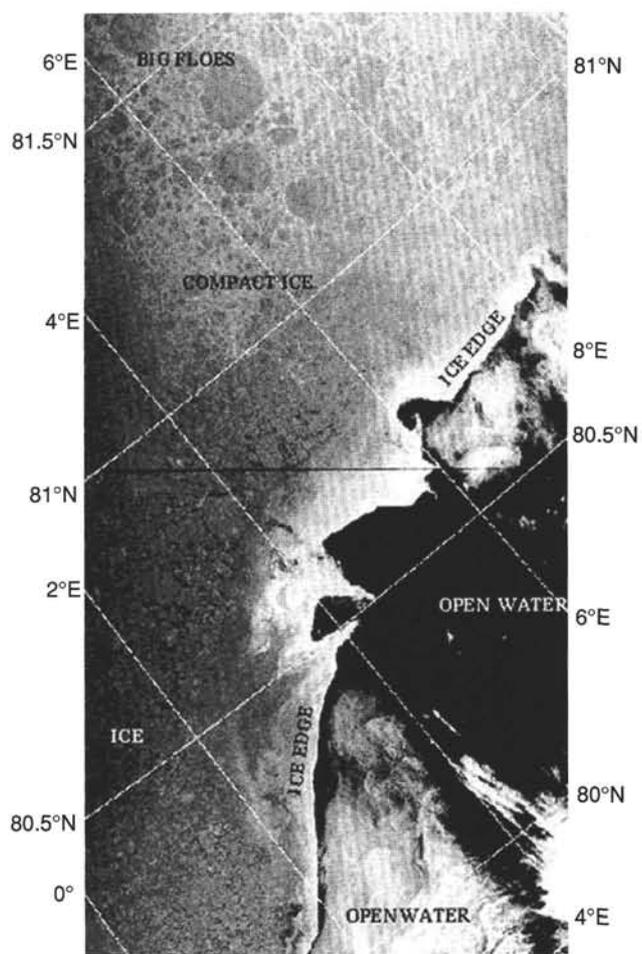


Figure 2. Satellite image; 12/08/93, 12:44; type = SAR Data analysis by NERSC. Copyright NERSC 1993 ESA.

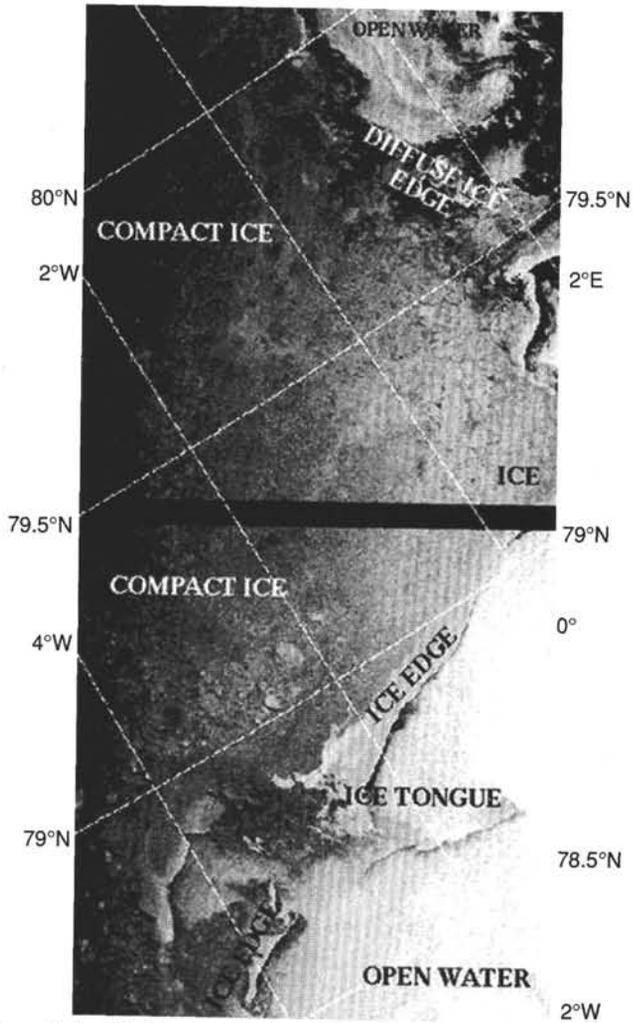


Figure 3. Satellite image; 12/08/93, 12:45; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

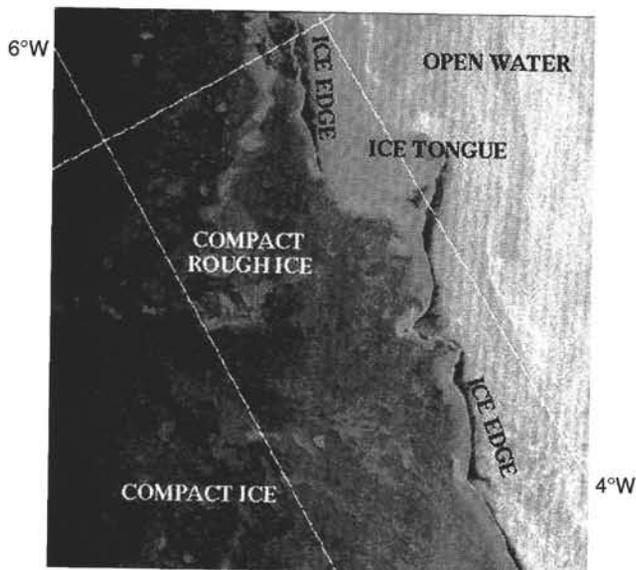


Figure 4. Satellite image; 12/08/93, 12:46; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

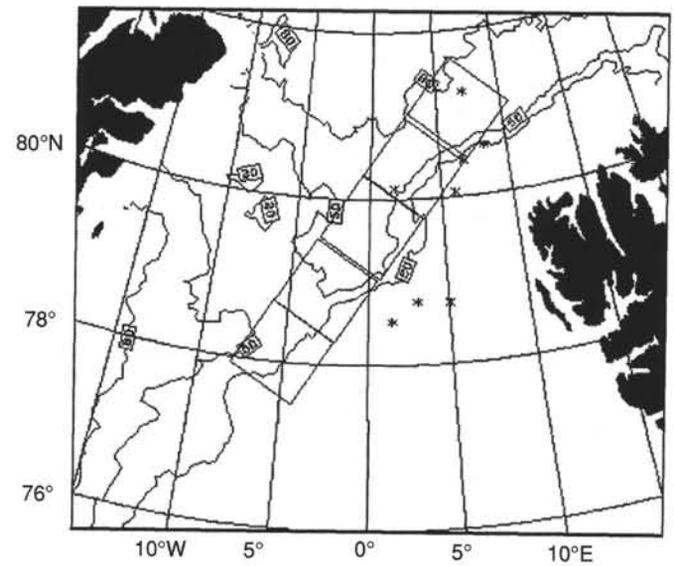


Figure 5. Satellite image; 13/08/93, type = SSMI; stars show drill sites. Data analysis by NERSC. Copyright NERSC 1993 ESA.

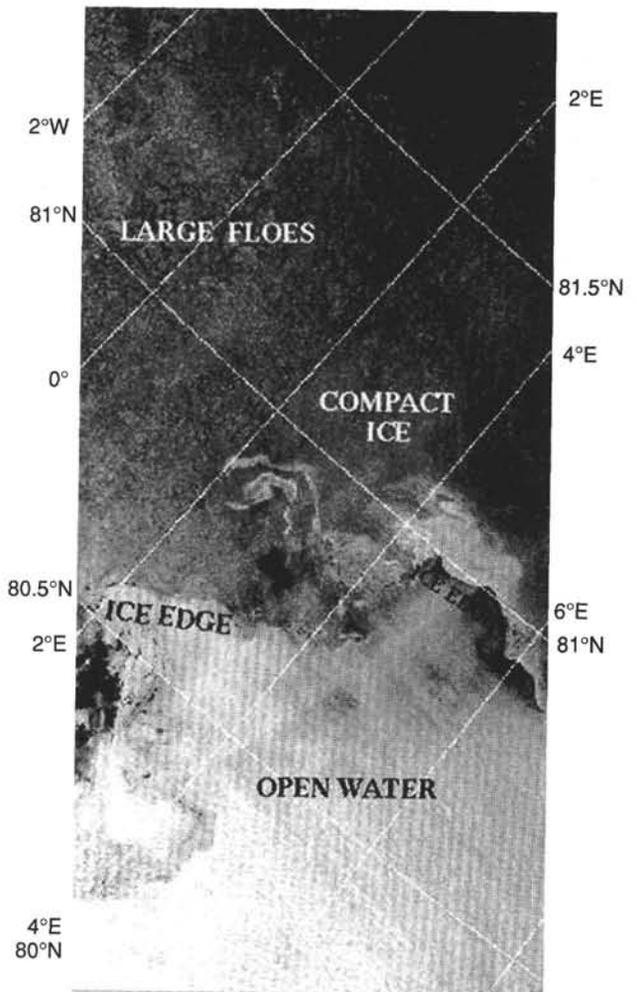


Figure 6. Satellite image; 21/08/93, 19:40; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

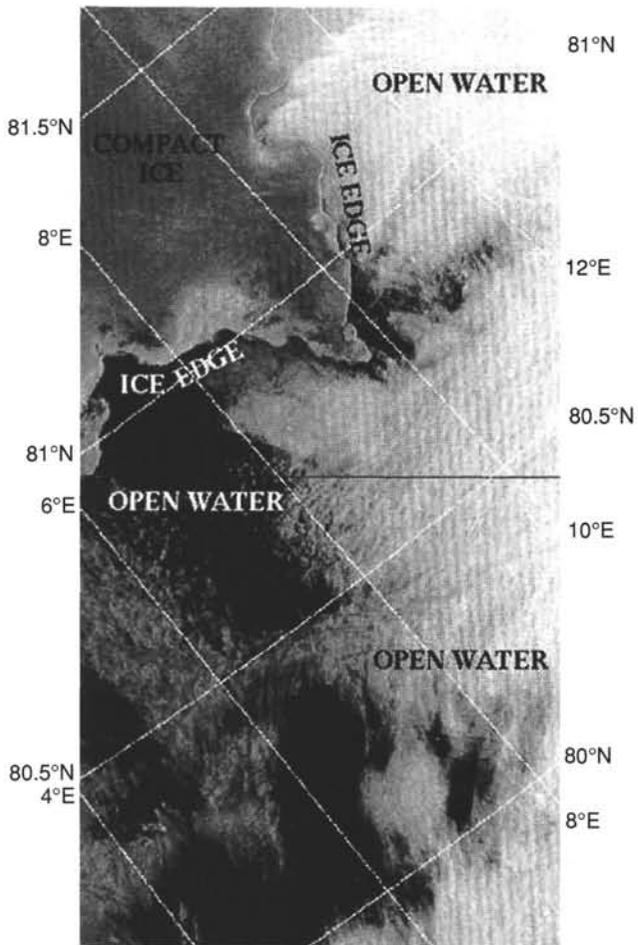


Figure 7. Satellite image; 22/08/93, 12:30; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

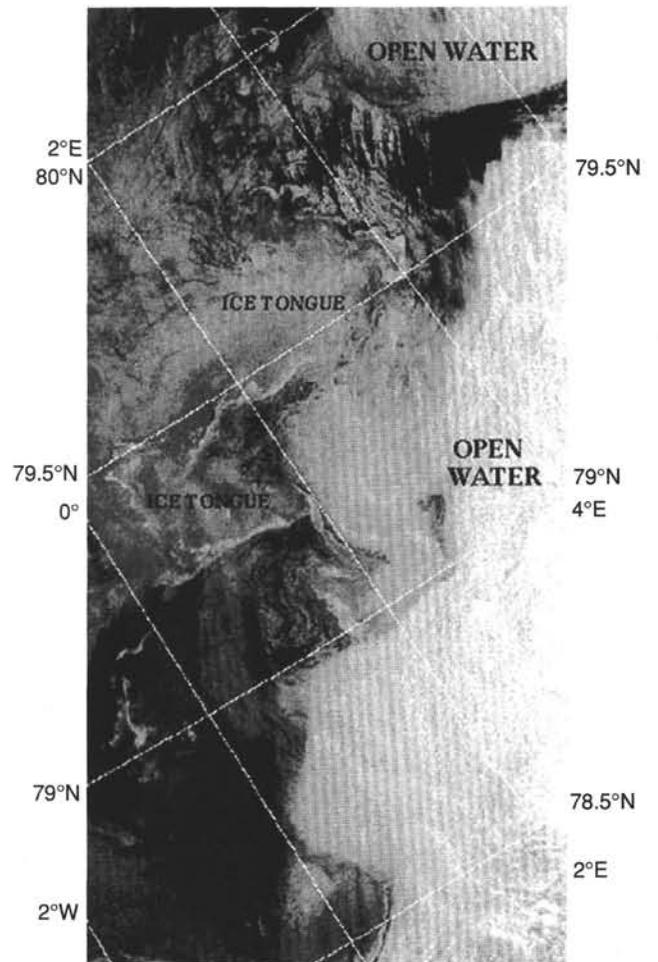


Figure 8. Satellite image; 22/08/93, 12:50; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

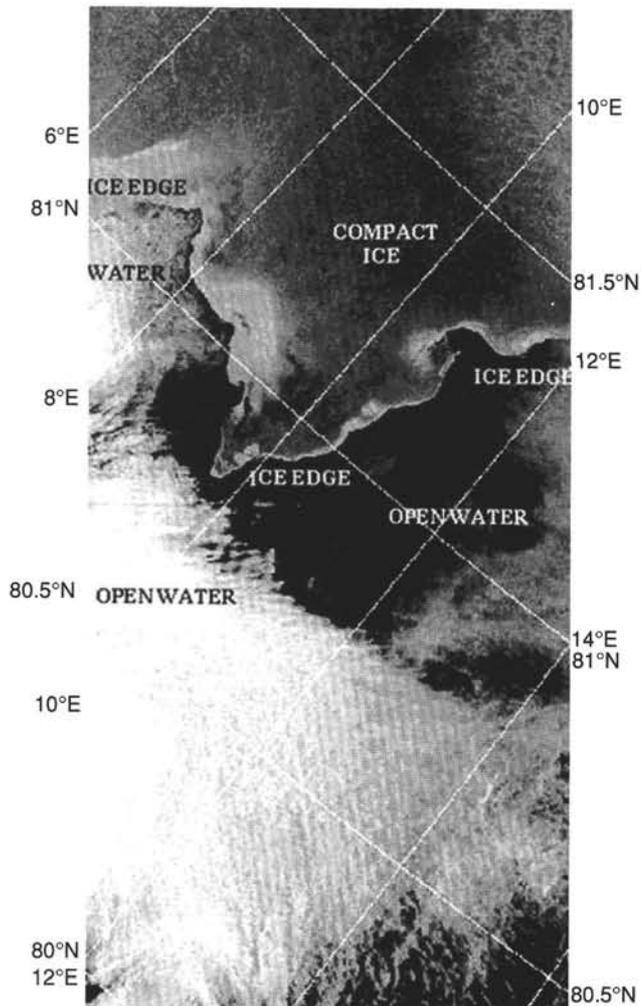


Figure 9. Satellite image; 22/08/93, 19:08; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

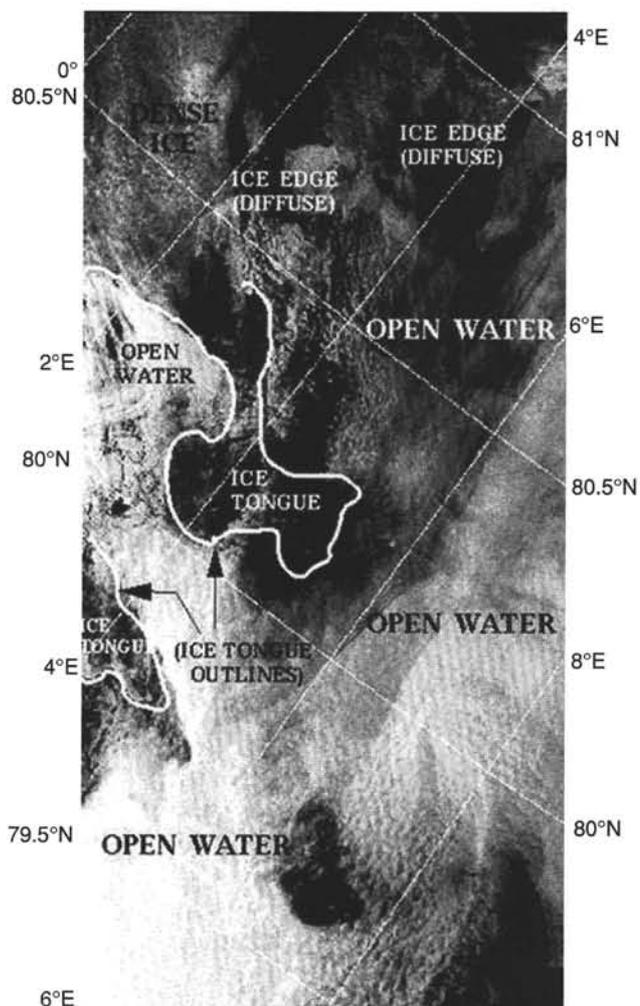


Figure 11. Satellite image; 24/08/93, 19:45; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

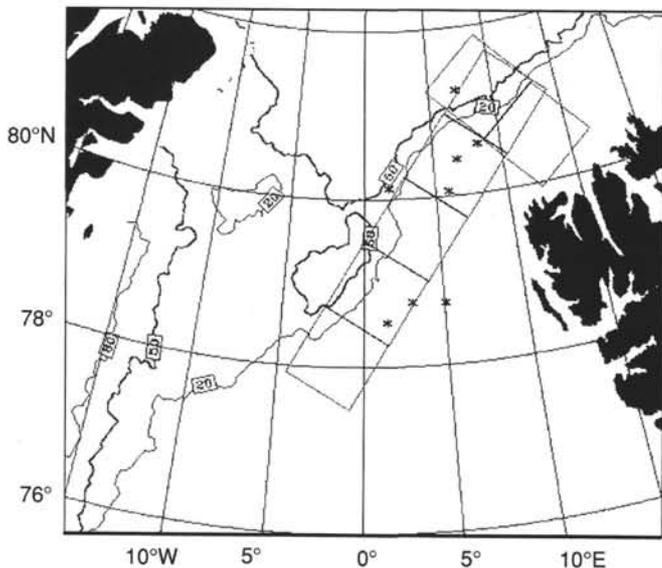


Figure 10. Satellite image; 23/08/93; type = SSMI; stars show drill sites. Data analysis by NERSC. Copyright NERSC 1993 ESA.

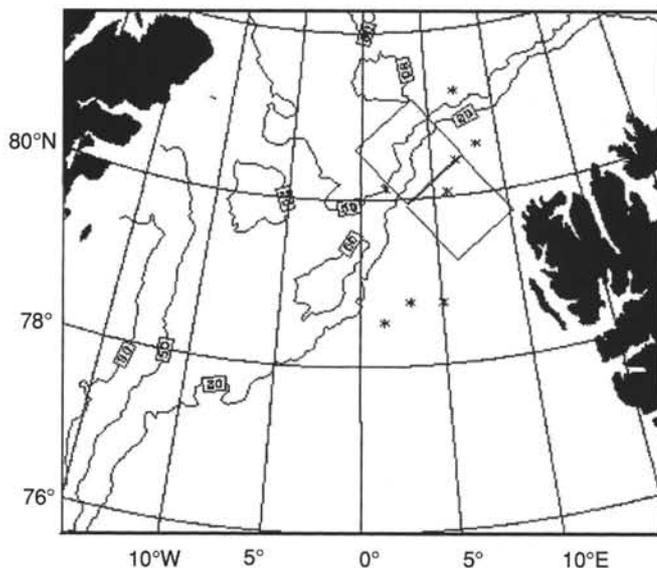


Figure 12. Satellite image; 25/08/93, type = SSMI; stars show drill sites. Data analysis by NERSC. Copyright NERSC 1993 ESA.

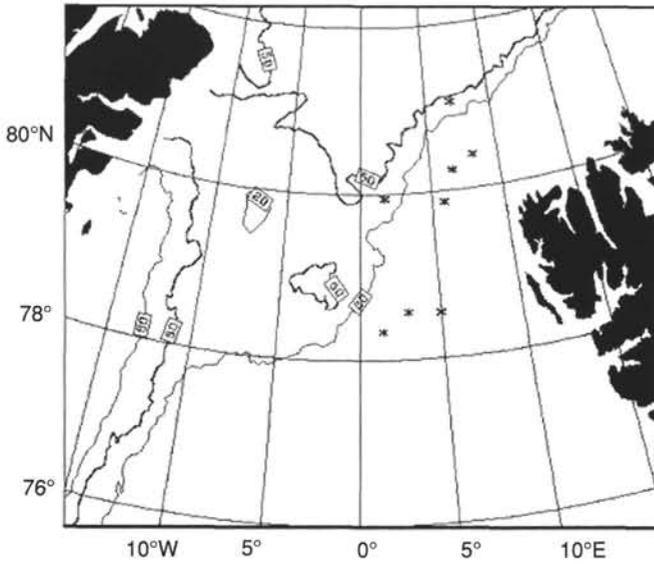


Figure 13. Satellite image; 27/08/93; type = SSMI; stars show drill sites. Data analysis by NERSC. Copyright NERSC 1993 ESA.

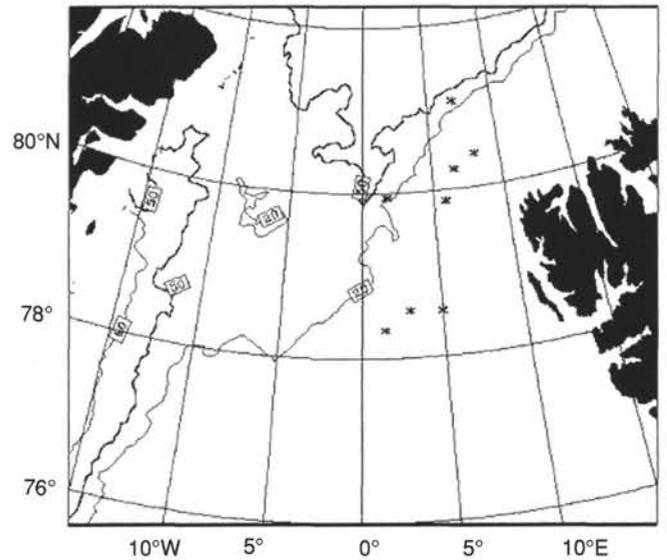


Figure 15. Satellite image; 30/08/93; type = SSMI. Data analysis by NERSC. Copyright NERSC 1993 ESA.

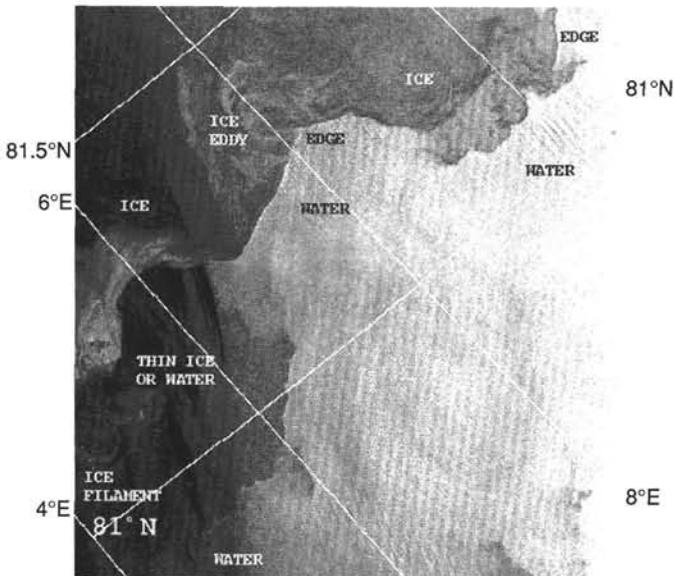


Figure 14. Satellite image; 28/08/93, 12:41; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

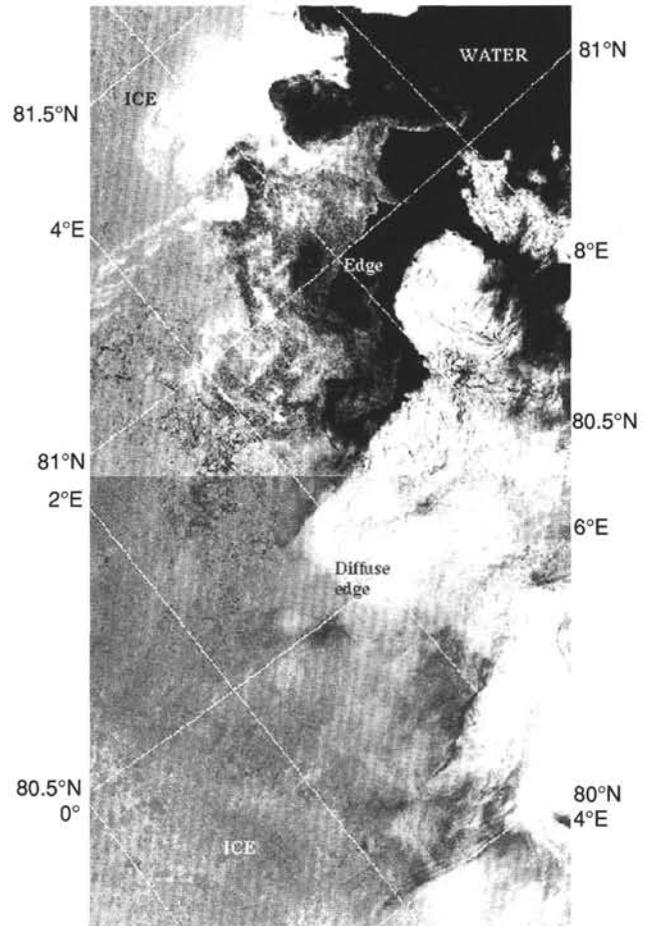


Figure 16. Satellite image; 31/08/93, 12:47; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

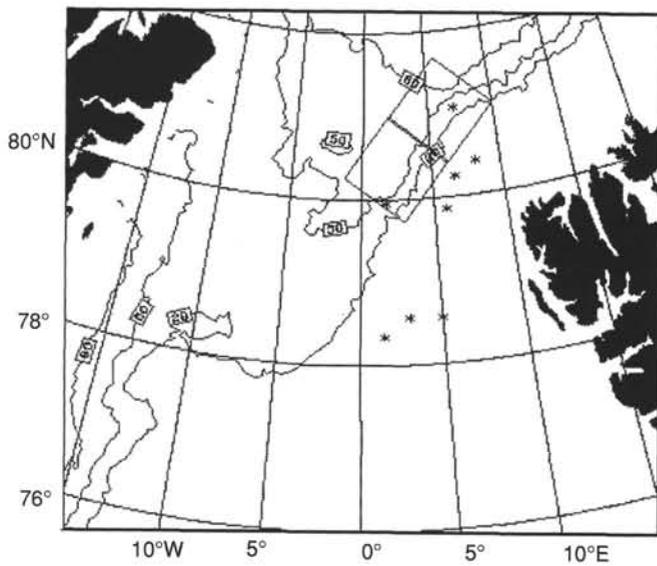


Figure 17. Satellite image; 01/09/93; type = SSMI; stars show drill sites. Data analysis by NERSC. Copyright NERSC 1993 ESA.

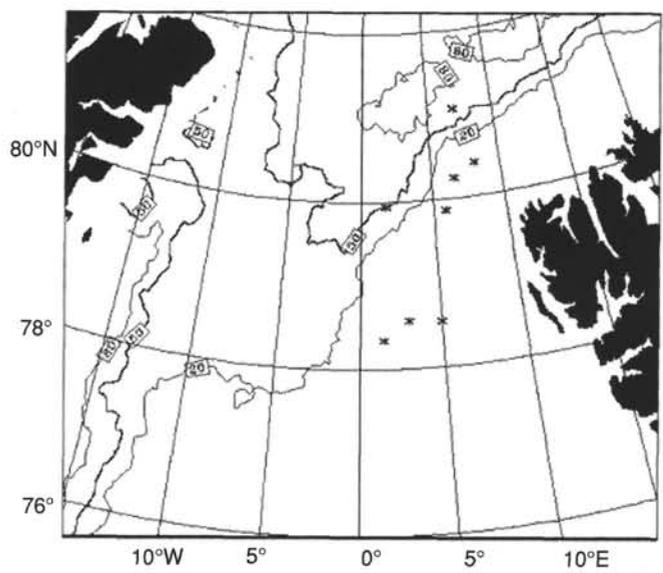


Figure 19. Satellite image; 03/09/93; type = SSMI; stars show drill sites. Data analysis by NERSC. Copyright NERSC 1993 ESA.

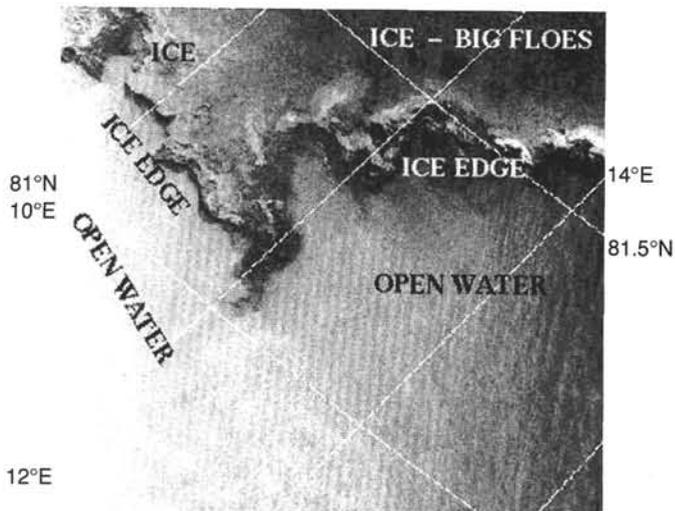


Figure 18. Satellite image; 01/09/93, 18:54; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

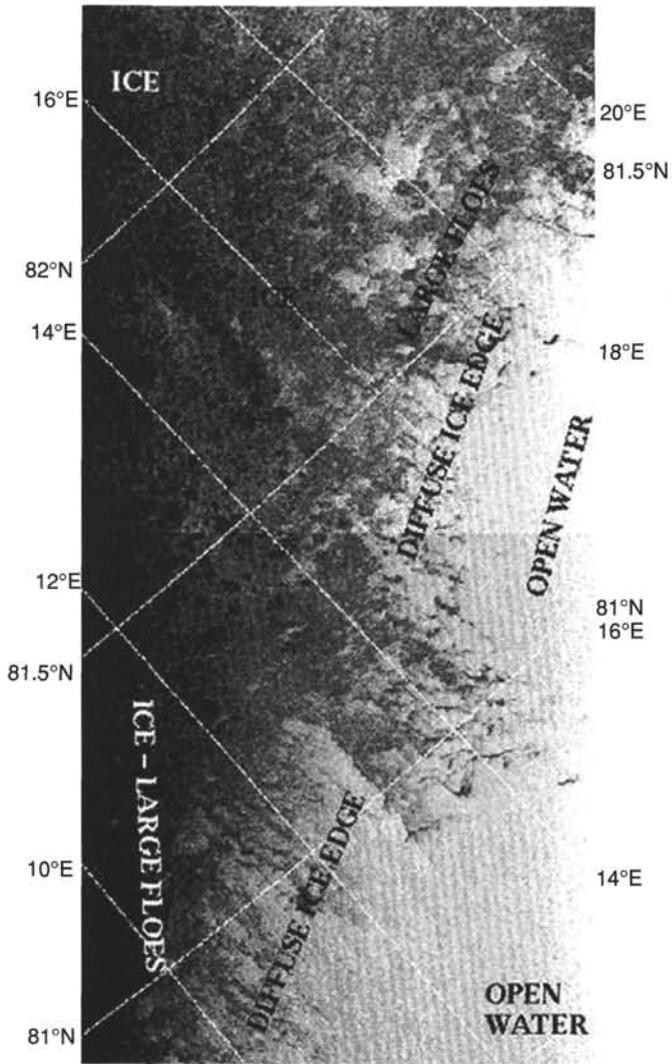


Figure 20. Satellite image; 04/09/93, 12:21; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

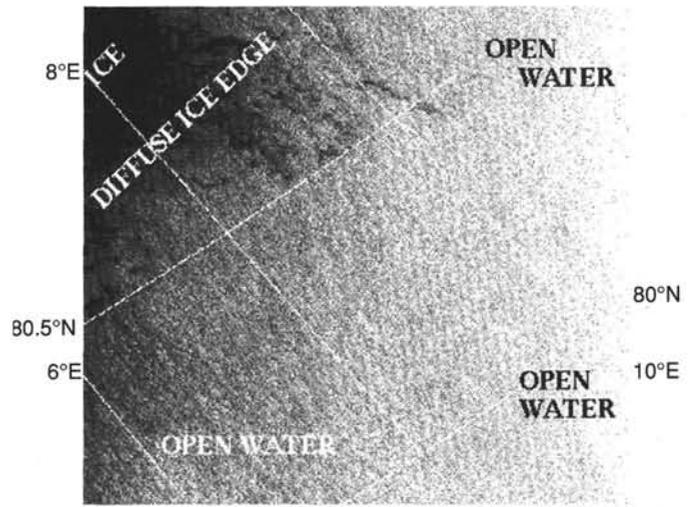


Figure 21. Satellite image; 04/09/93, 12:22; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

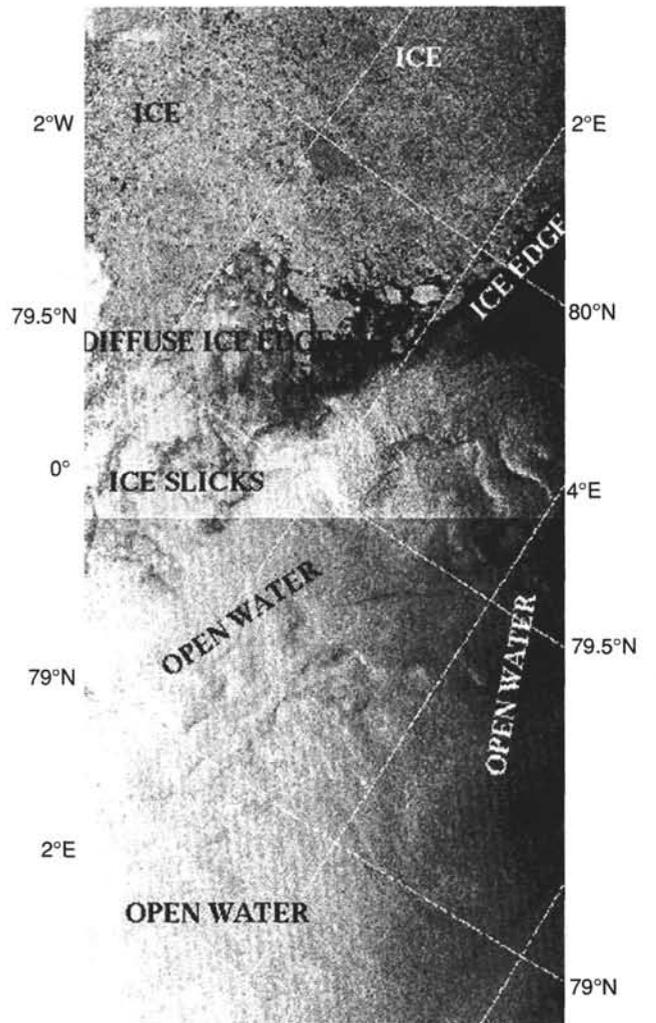


Figure 22. Satellite image; 05/09/93, 20:08; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

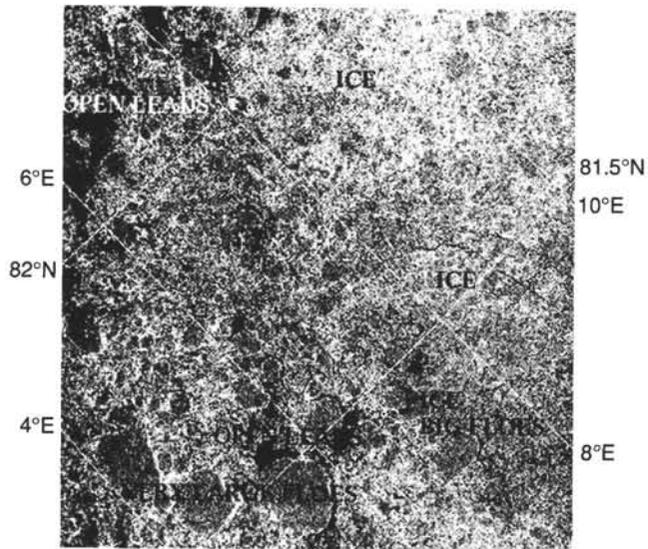


Figure 23. Satellite image; 06/09/93, 12:59; type = SAR. Data analysis by NERSC. Copyright NERSC 1993 ESA.

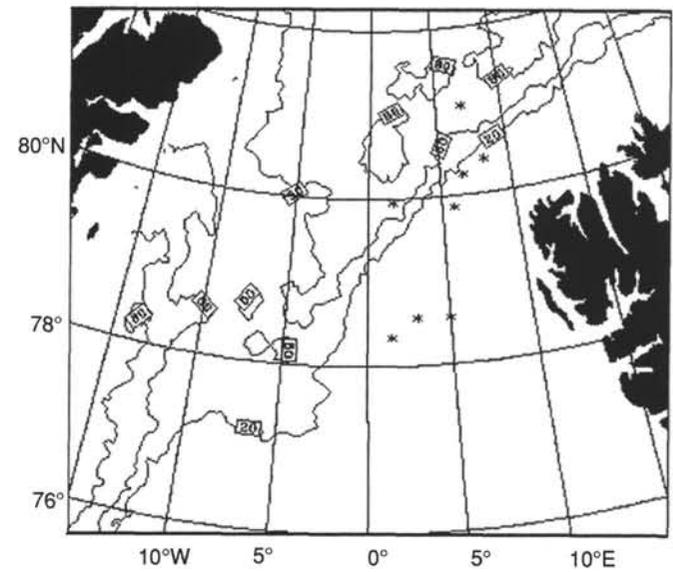


Figure 25. Satellite image; 07/09/93; type = SSMI; stars show drill sites. Data analysis by NERSC. Copyright NERSC 1993 ESA.

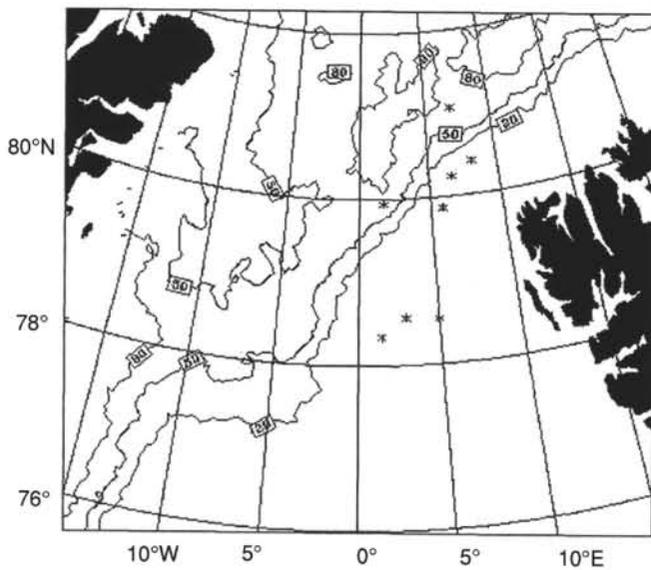


Figure 24. Satellite image; 06/09/93; type = SSMI; stars show drill sites. Data analysis by NERSC. Copyright NERSC 1993 ESA.

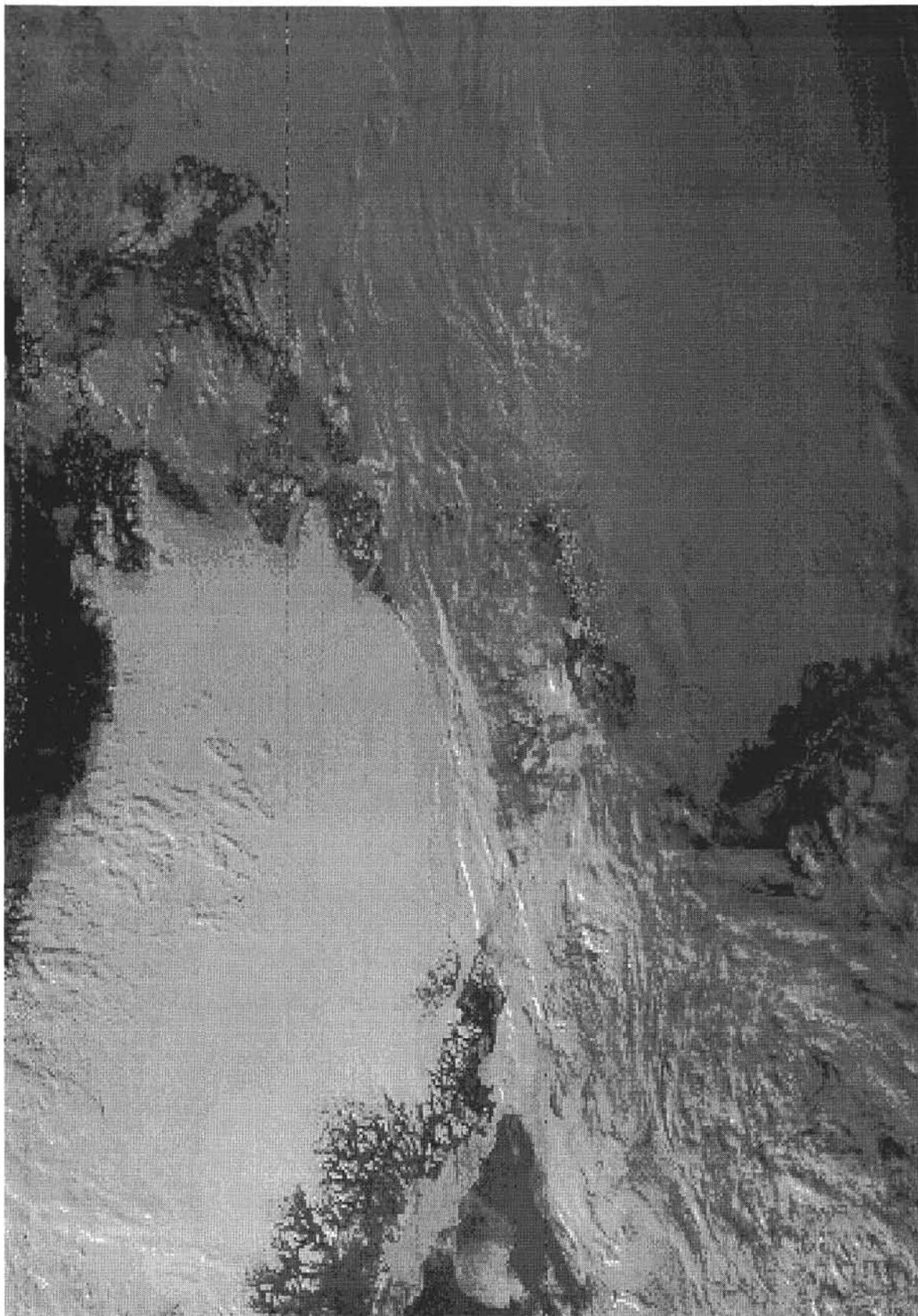


Figure 26. Satellite image; type = METEOR; sample image; Greenland and the "whaler's bight" to the North of Svalbard are clearly visible. Data analysis by NERSC. Copyright NERSC 1993 ESA.

APPENDIX B
Ship's Charts

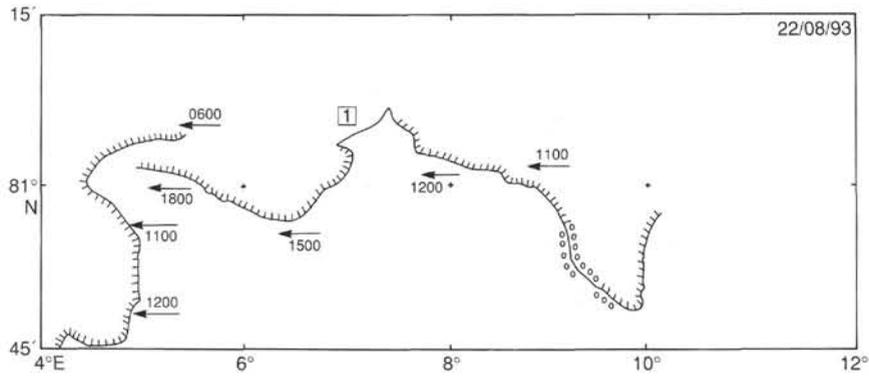


Figure 1. Ship's chart from 22/08/93 to 23/08/93.

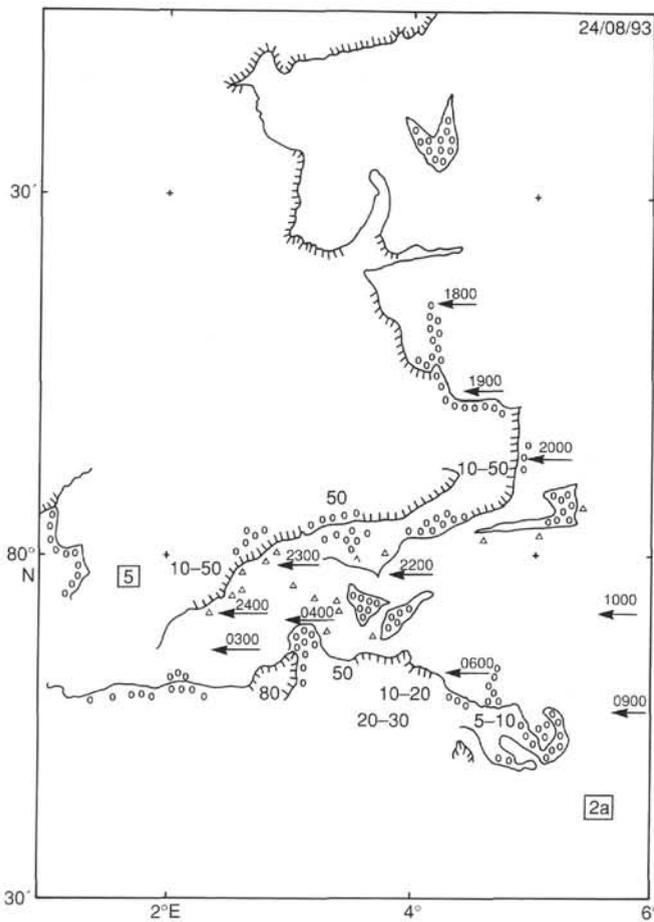


Figure 2. Ship's chart from 23/08/93 to 24/08/93.

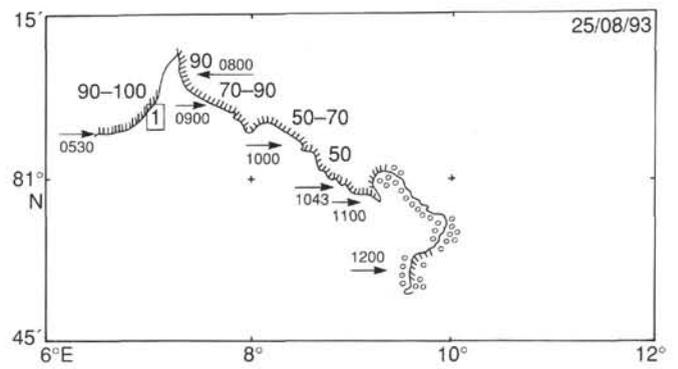


Figure 3. Ship's chart, 25/08/93.

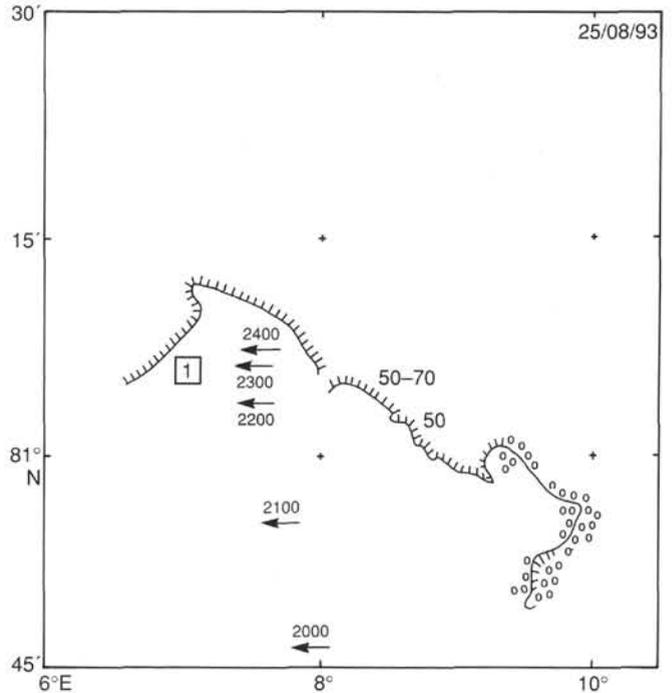


Figure 4. Ship's chart, 25/08/93.

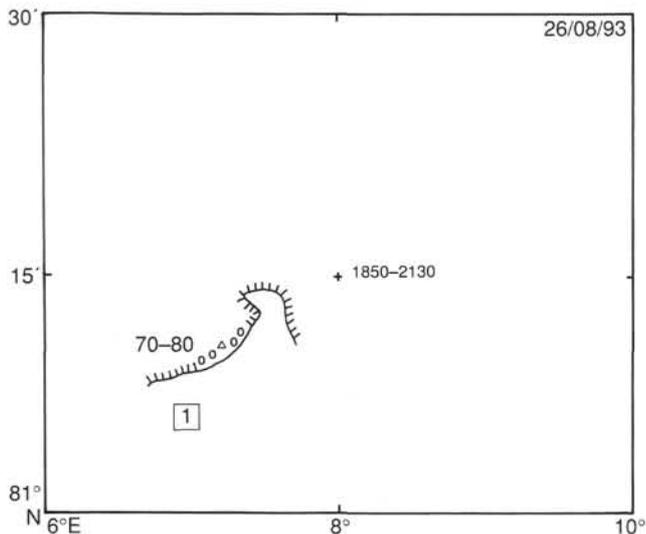


Figure 5. Ship's chart, 26/08/93.

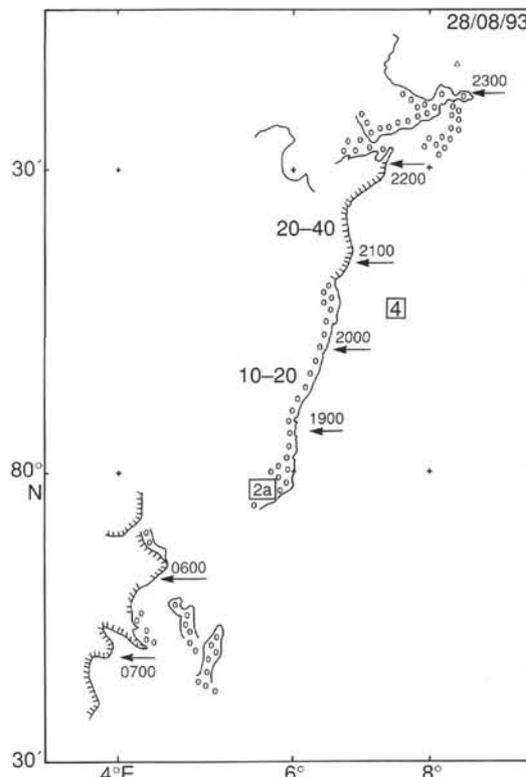


Figure 7. Ship's chart, 28/08/93.

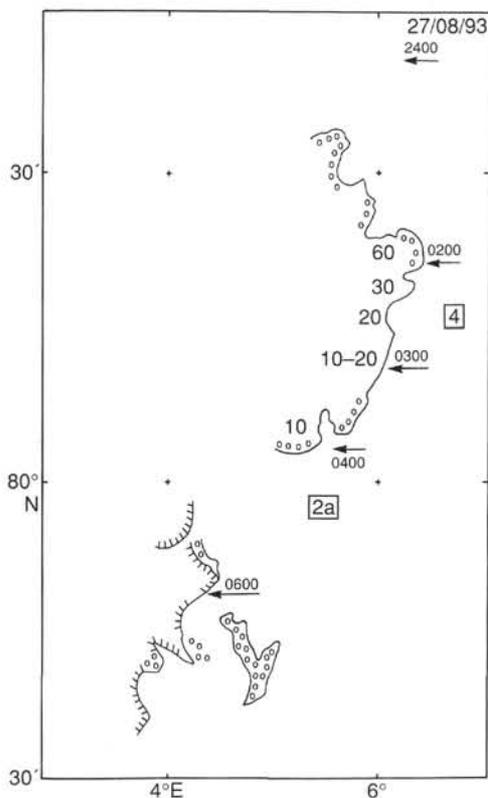


Figure 6. Ship's chart, 27/08/93.

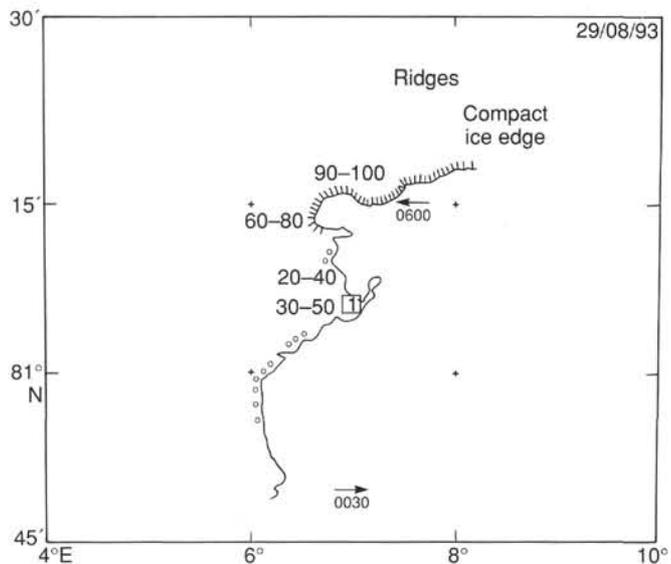


Figure 8. Ship's chart, 29/08/93.

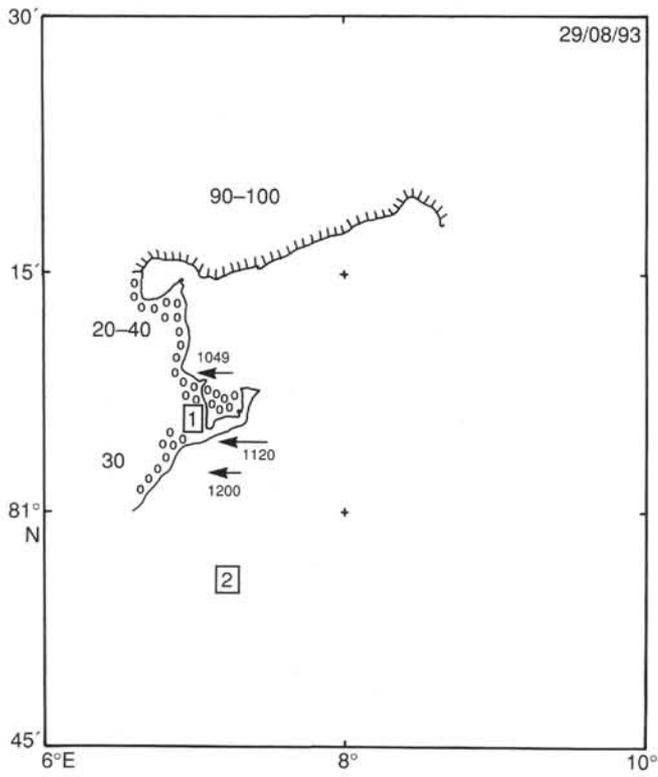


Figure 9. Ship's chart, 29/08/93.

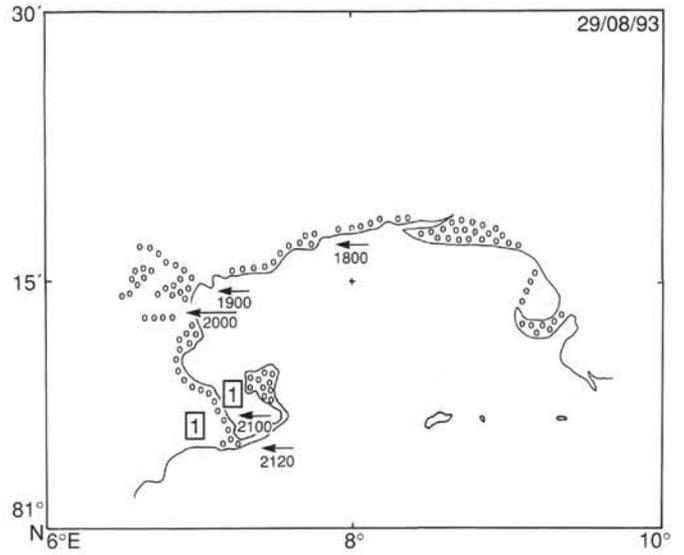


Figure 10. Ship's chart, 29/08/93.

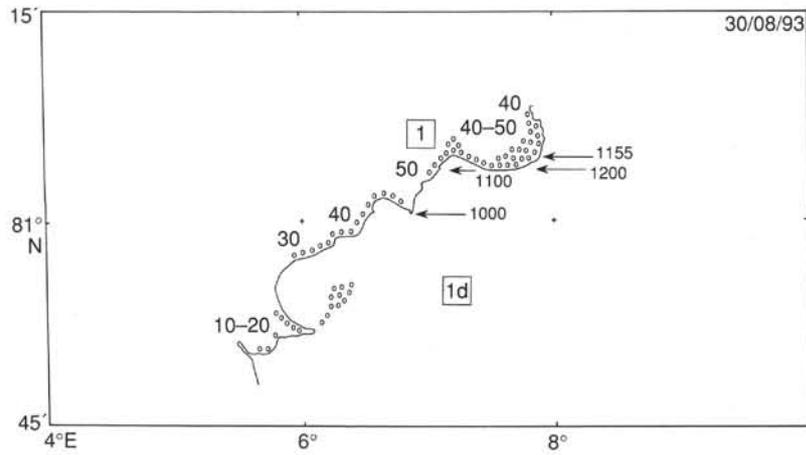


Figure 11. Ship's chart, 30/08/93.

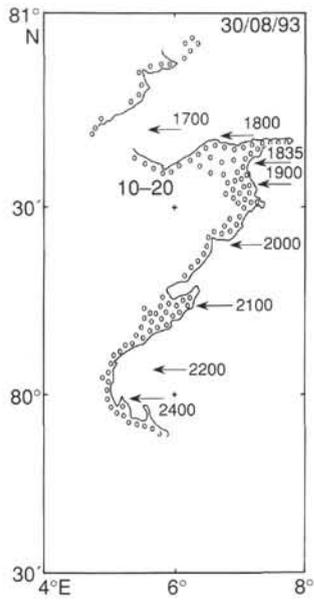


Figure 12. Ship's chart, 30/08/93.

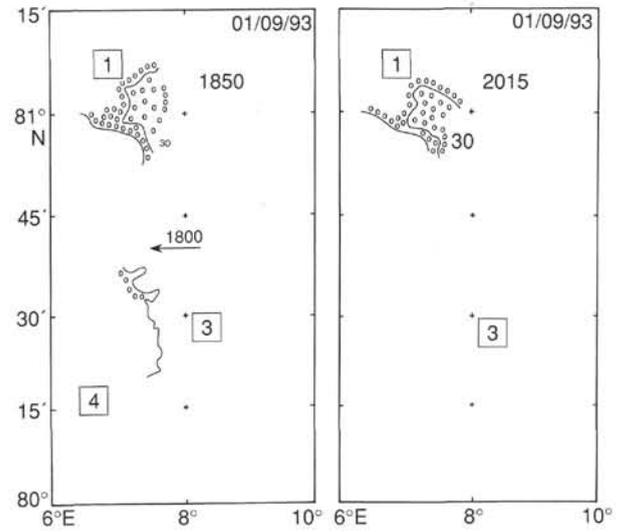


Figure 14. Ship's chart, 01/09/93.

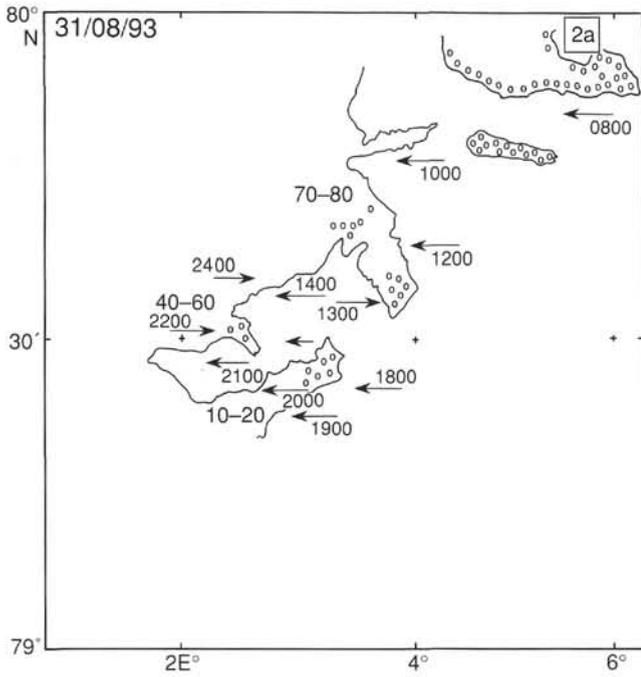


Figure 13. Ship's chart, 31/08/93.

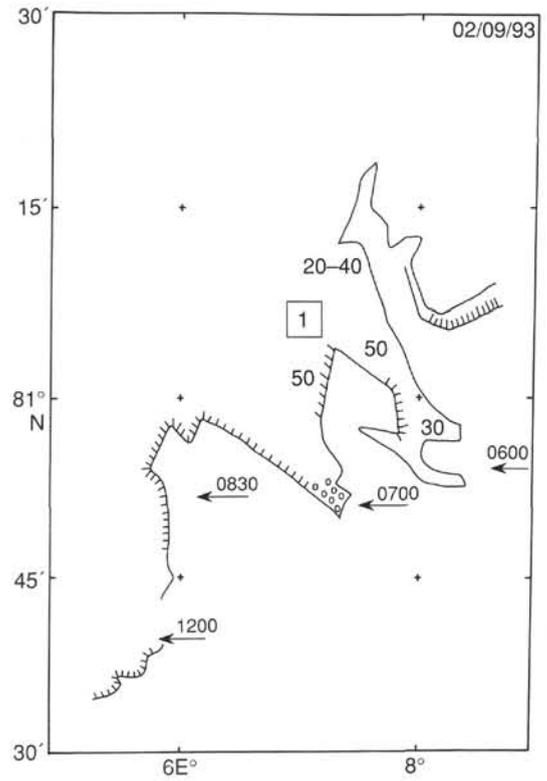


Figure 15. Ship's chart, 02/09/93.

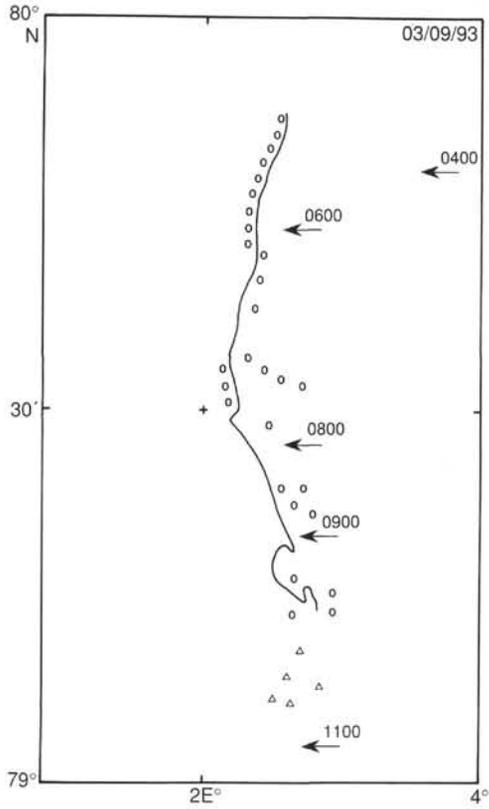


Figure 16. Ship's chart, 03/09/93.

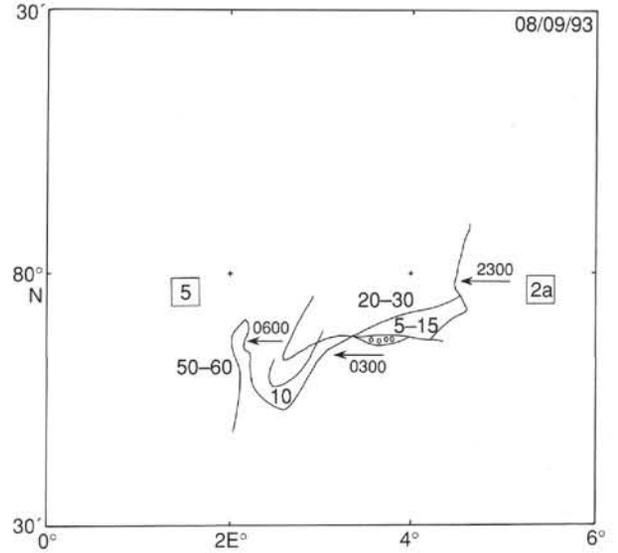


Figure 18. Ship's chart from 08/09/93 to 09/09/93.

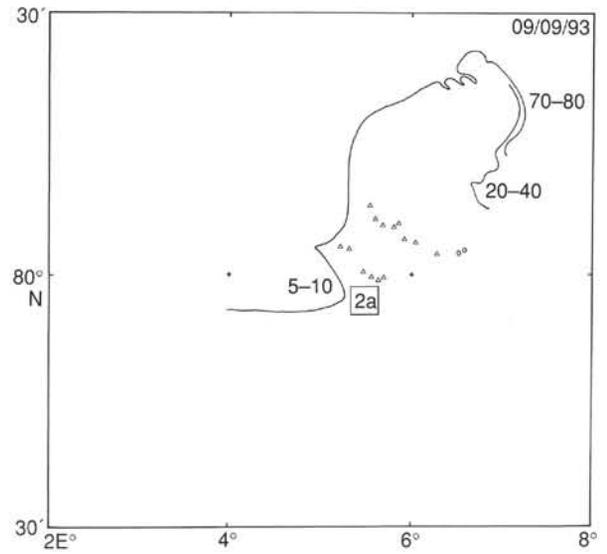


Figure 19. Ship's chart, 09/09/93.

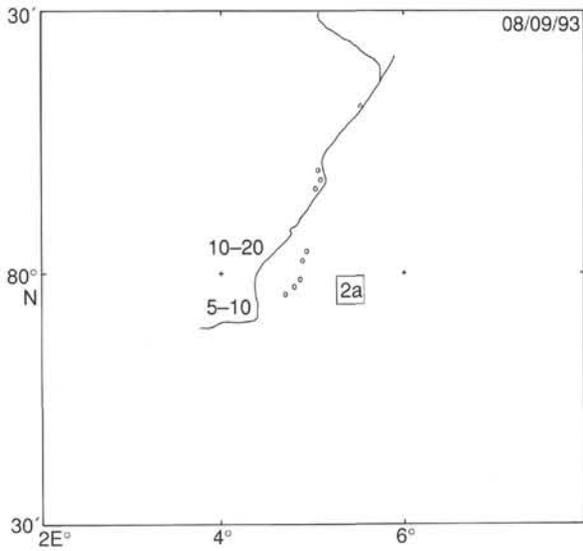


Figure 17. Ship's chart, 08/09/93.

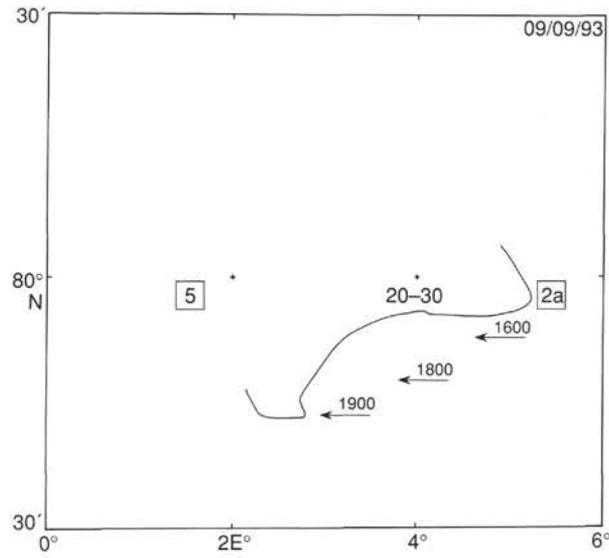


Figure 20. Ship's chart, 09/09/93.

APPENDIX C
Photographs

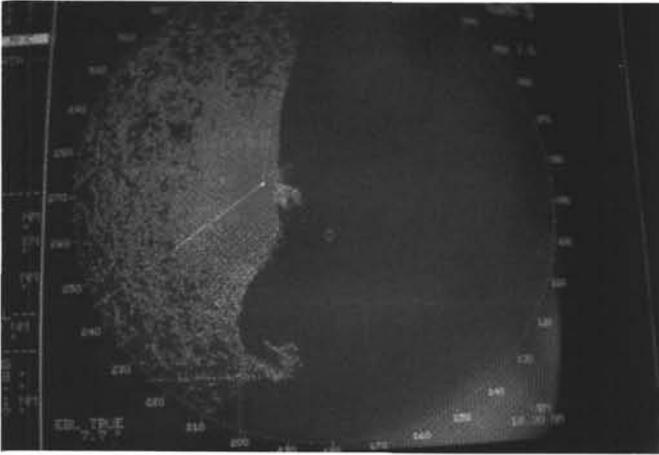


Figure 1. Gyre at ice edge visible on radar. 17/08/93, 20:50.



Figure 2. Core sample site; mixture of small floes and brash. 17/08/93, 23:30.

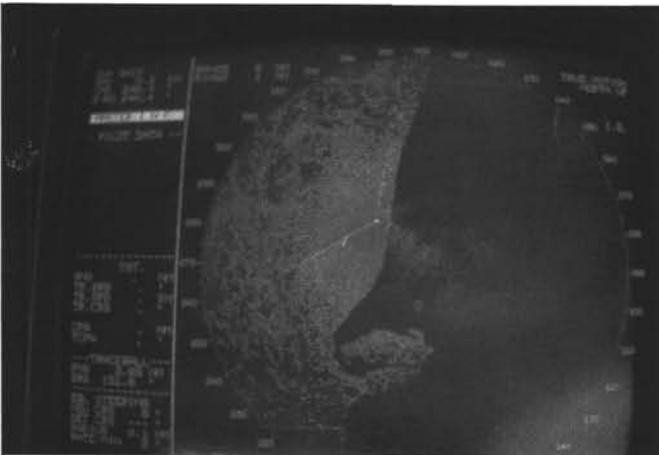


Figure 3. Gyre at ice edge (Fig. 1) developing. 18/08/93, 02:00.



Figure 4. Floes at the ice edge showing low freeboard and melt pools. 19/08/93, 00:10.



Figure 5. As in Figure 4. 19/08/93, 00:10.



Figure 6. Cover 70%. "Fennica" logo on ship's helo-deck. 19/08/93, 09:00.



Figure 7. As in Figure 6. 19/08/93, 09:00.



Figure 8. First-year ice. 20/08/93, 04:00.



Figure 9. First-year ice, 5% melt pools. 20/08/93, 06:10.



Figure 10. Melt pools and surface roughness visible. 25/08/93, 12:35.



Figure 11. Cover 90%–100%. 25/08/93, 12:35.



Figure 12. Ice edge. 27/08/93, 19:40.



Figure 13. Ice edge. 27/08/93, 19:40.



Figure 14. Compact ice edge. 29/08/93, 18:50.



Figure 15. Compact ice edge. 29/08/93, 18:50.



Figure 16. Floe at the ice edge. 29/08/93, 19:10.



Figure 17. Ice edge, *Fennica* stern gantry. 29/08/93, 19:10.



Figure 18. 30/08/93, 10:50.



Figure 19. 30/08/93, 10:50.



Figure 20. Edge of ice tongue. 31/08/93, 18:30.



Figure 21. Ice in the edge. 31/08/93, 18:30.



Figure 22. 31/08/93, 24:00.



Figure 23. 31/08/93, 24:00.



Figure 24. Cover 90%. 01/09/93, 02:30.



Figure 25. As in Figure 24. Ice edge just visible. 01/09/93, 02:30.



Figure 26. 01/09/93, 04:00.



Figure 27. Bands of varying concentration 200 m from the ice edge. 01/09/93, 04:30.



Figure 28. 07/09/93, 08:40.



Figure 29. 07/09/93, 09:00.



Figure 30. 07/09/93, 11:30.



Figure 31. 07/09/93, 11:30.



Figure 32. Ice edge band. 08/09/93, 09:00.



Figure 33. 10/09/93, 14:00.